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ANNUAL REPORT

OF

THE BOARD OF REGENTS

OF THE

UNIVERSITY OF MINNESOT

TO THE GOVERNOR,

FOR THE

FISCAL YEAR ENDING NOVEMBER 30, 1875.

TRANSMITTED TO THE LEGISLATURE OF THE EIGHTEENTH ANNUAL SESSION, 1876.

ST. PAUL:
THE PIONEER-PRESS COMPANY.
1876.

[EXECUTIVE DOCUMENT No. 18.]

ANNUAL REPORT

OF

THE BOARD OF REGENTS

OF THE

UNIVERSITY OF MINNESOTA

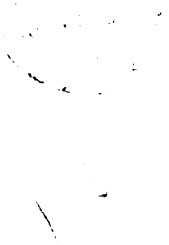
TO THE GOVERNOR,

FOR THE

FISCAL YEAR ENDING NOVEMBER 30, 1875.

TRANSMITTED TO THE LEGISLATURE OF THE EIGHTEENTH ANNUAL SESSION, 1876.

SAINT PAUL:
THE PIONEER-PRESS COMPANY.
1876.



MINNEAPOLIS, Dec. 21, 1875.

To his Excellency, C. K. Davis, Governor of Minnesota:

SIR:—In compliance with the law, I have the honor to forward herewith the annual report of the Board of Regents of the University of Minnesota for the fiscal year ending Dec. 21, 1875.

I have the honor to be

Your obedient servant,

J. S. PILLSBURY,

President of the Board of Regents.

BOARD OF REGENTS.

HON. H. H. SIBLEY, Saint Paul.....1876.
HON. CHARLES S. BRYANT, Saint Peter...1876.
HON. J. S. PILLSBURY, Minneapolis.....1877.
HON. PARIS GIBSON, Minneapolis.....1877.
HON. MORRIS LAMPREY, Saint Paul.....1877.
HON. WM. R. MARSHALL, Saint Paul.....1878.
HON. A. A. HARWOOD, Austin.....1878.

MEMBERS EX-OFFICIO.

HON. C. K. DAVIS, Governor of Minnesota, Saint Paul.
HON. D. BURT, Superintendent of Public Instruction, Saint Paul.
HON. WM. W. FOLWELL, President of the University, Minneapolis.

REPORT.

THE FACULTY.

A few changes have been made in the board of instruction since our last report.

Lieut. E. L. Huggins, U. S. A., Professor of Military Science and Tactics, returned to duty with his regiment at the close of the academic year, in compliance with an order from the Secretary of War. The Regents are in correspondence with several gentlemen with a view to securing a successor, and hope soon to have another suitable person detailed.

The following officers, who had previously held the rank of assistant professor or instructor, have been elected professors:

Mitchell D. Rhame, M. A., department of Civil and Mechanical Engineering.

Stephen F. Peckham, M. A., department of Chemistry and Physics.

John G. Moore, B. A., department of German Language and Literature.

Moses Marston, M. A., department of English Language and Literature.

At the same time, the following officers were elected assistant Professors, and placed in charge of departments:

Richard W. Laing, LL. D., in charge of the department of History.

Charles Y. Lacy, B. Agr., in charge of the department of Agriculture.

The Faculty is now made up as follows:

WILLIAM W. FOLWELL, M. A., PRESIDENT,
Instructor of Political Economy and Librarian.

G. CAMPBELL, M. A. B. D., VICE-PRESIDENT,
Professor of Mental and Moral Philosophy.

VERSAL J. WALKER, M. A.,
Professor of the Latin Language and Literature.

JABEZ BROOKS, M. A., D. D.,
Professor of the Greek Language and Literature.

EDWIN J. THOMPSON, M. A.,
Professor of Mathematics and Astronomy.

NEWTON H. WINCHELL, M. A.,
Professor of Geology and Mineralogy.

MITCHELL D. RHAME, M. A.,
Professor of Civil and Mechanical Engineering.

STEPHEN F. PECKHAM, M. A.,
Professor of Chemistry and Physics.

JOHN G. MOORE, B. A.,
Professor of the German Language and Literature.

MOSES MARSTON, M. A.,
Professor of the English Language and Literature.

HELEN SUTHERLAND, M. A.,
Preceptress and Assistant Professor of Latin.

RICHARD W. LAING, LL. D.,
Assistant Professor in Charge of History and Elocution.

CHARLES Y. LACY, B. AGR.,
Assistant Professor in charge of Agriculture.

CHARLES N. HEWITT, M. D.,
Non-Resident Professor Public Health.

LOUIS W. PECK,
Instructor of Physics and Drawing.

GRADUATES.

At the close of the University year, in June last, seven persons were graduated—six young gentlemen and one young lady. The latter is the daughter of Rev. Edward Ely, of Winona, and is the first lady who has taken a degree at the University. The present senior class numbers fourteen members. It is anticipated that at least ten will complete a course.

ATTENDANCE.

College or Department.	Class.	Gentlemen.	Ladies.	Total.
Science, Literature and the Arts	Seniors.	4	1	5
	Juniors.	11	1	12
Mechanic Arts	Seniors.	3	..	3
	Juniors.	4	..	4
Agriculture, Elementary course.		2	..	2
Collegiate Department	First.	17	3	20
	Second.	29	10	39
	Third.	42	10	52
	Fourth.	68	18	86
	Special.	8	6	14
Totals		188	49	237

OR BY CLASSES ONLY.

Seniors—of all Departments		8	
Juniors— " " "		16	
Sophomores—First Class, Collegiate Department		20	
Freshmen—Second Class, " "		39	83
Preparatory	Third Class, " "	52	
	Fourth Class, " "	86	
Special—14; Agricultural, 2		16	
Total			237

COMPLETION OF BUILDINGS.

As stated in our last report, the work of finishing the new buildings had been much delayed. The progress of the contractors was so unsatisfactory, that the Regents made a settlement with them and canceled the contract. Mr. T. H. Goodale, of Minneapolis, was subsequently employed to superintend the completion of the buildings. Under his direction the work has been carried forward as rapidly as practicable. The main hall was occupied for commencement exercises in June last, and the recitation rooms

in the same building assigned to the professors at the opening of the present year. The Laboratory, in the Agricultural College, has been finished, and fully furnished, and is in good working order.

The Regents are gratified to report that the entire cost of erecting these two buildings, in accordance with the plans adopted, has not exceeded sixty-eight thousand dollars, including all extras—a sum which is within their estimate for the work.

CHARACTER OF THE BUILDINGS.

The Regents feel no little satisfaction in calling attention to the edifices thus put in readiness. They form all that is deemed requisite for the present wants of the Institution.

The walls of the main building have been erected under the careful supervision of an experienced builder. Its various interior arrangements are in accordance with the most approved plans of our best colleges. The main building is ninety feet in length by sixty-five feet in width, and four stories high, including the basement. The upper story consists of a general assembly hall, which affords a seating capacity for one thousand persons. The second story contains recitation rooms, and other apartments for the professors. The first floor is devoted to the library, reading room, regents' room, and ladies' parlor. The building is warmed throughout with Ide's steam heating apparatus, in connection with which there is a complete system of ventilation.

AGRICULTURAL BUILDING.

The Agricultural College building is fifty-four feet by fifty-four feet—with two wings twenty-five feet by forty feet each.

The central structure of the Agricultural College is three stories high, basement included. The upper story is devoted to lecture rooms, and to collections of agriculture and chemical technology. The first story is divided into recitation rooms for botany and chemistry and experiments, for the geological survey, and experimental farm.

The east wing is a plant house, and the west wing a laboratory. The latter has been planned with great care, and affords most excellent accommodations for students pursuing applied chemistry. Under the direction of the professor of Chemistry, a considerable number of persons are already occupying it for that purpose, and it is believed that the laboratory of the Agricultural College will compare

favorably with like institutions in the Northwest. It is fully equipped for making analyses of objects furnished not only by the agricultural department, but by the geological survey or by private parties.

MUSEUM.

During the past year an extensive collection of casts and fossil animals, prepared by Professor Ward, of Rochester, has been secured. The cost of the collection was sixteen hundred dollars; of this amount the greater part was paid by a few leading citizens of Minneapolis, [for names see Curator's report,] who generously contributed to this object. Adjoining the department of geology a room has been fitted up for the classification of this collection, and also for the display of material obtained from the geological survey. Altogether these will form a fine geological cabinet, adapted for class illustration, as well as for exhibition to the general public.

LIBRARY.

The new apartments for library and reading room are on the first floor of the main building. The different collections of books which have heretofore been kept in two separate rooms are now conveniently arranged. All the books have been catalogued, and are accessible to students, professors, and the public generally.

UNIVERSITY CAMPUS.

After making inquiry from various sources as to the ornamentation of the University campus, the Regents have adopted the recommendation of Professor Cleveland, of Chicago, a landscape artist of high reputation, and he has submitted plans of the work to be done. The grounds have already been laid out. During the coming summer the grading, walks, drives, &c., will be completed according to the specifications. When this is done, this site—naturally picturesque—will be much improved in appearance. The University will truly be "beautiful for situation," and unusually attractive to the youth of our State.

SALT SPRING LANDS.

Under the Enabling Act of Congress of 1857, by which Minnesota

was admitted into the Union, Congress granted to the State seventy-two sections of salt spring lands. Regent Sibley, the first governor of Minnesota, had the springs designated and lands located according to the terms of the act. Subsequently it was ascertained that eighteen sections had been selected outside of the area surveyed by the general government, and owing to the negligence of the United States land officers in the districts where the other lands were located, and the destruction by fire of a part of their records, in 1862, no adequate account was kept of the selections made. By reason of this neglect, for which our State officers are in no way responsible, a number of sections of these lands were pre-empted, and others located as swamp lands. There is thus an aggregate deficit of a little more than thirty-one sections, (19,872 acres,) which are still due to the State.

In order to secure these lands for the purposes for which they have been set apart, namely, the support of the geological and natural history of the State, the Board of Regents would respectfully request that the Legislature memorialize Congress for permission to select other lands in lieu of the above mentioned deficiency.

For full particulars we would respectfully refer you to the accompanying report on the salt spring lands, prepared by the State Geologist.

SALT SPRING LANDS.

To the Board of Regents of the University of Minnesota:

The whole of the State Salt Spring Lands have been appropriated by the Legislature to the prosecution of the Geological and Natural History Survey of the State of Minnesota, under the direction of the Board of Regents of the State University. Upon investigating the condition of these lands, it has been ascertained that there is a large deficit in the amount granted by the General Government. This deficit arises from no fault of the State, or of its officers. The following history is sufficient to show that every step required by the terms of the grant was carefully taken. It is presented to the Board of Regents for their information, and for the purpose of calling the attention of the proper officers to the necessity of taking such measures as will secure to the work for which these lands have been set aside, the whole of the original grant.

N. H. WINCHELL,
State Geologist.

(*a.*) SELECTION OF THE LANDS UNDER GOVERNOR SIBLEY.

An Act of the United States Congress, approved February 26, 1857, authorized the people of the Territory of Minnesota to form a constitution preparatory to their admission into the Union. This act, well known as the Minnesota "Enabling Act," contained a clause granting to the new State, on its admission, certain amounts of land for different purposes. Among these were "twelve salt springs, with six sections of land adjoining or as contiguous as may be, to each." In compliance with this enabling act, Minnesota became a State May 11th, 1858, the first Governor being H. H. Sibley. The terms of the grant made it obligatory on the State to select the lands within two years after its admission into the Union.

In the latter part of August of the same year, Governor Sibley addressed the following letter to the commissioners appointed to select the salt spring lands:

EXECUTIVE OFFICE, ST. PAUL,
August 23, 1858.

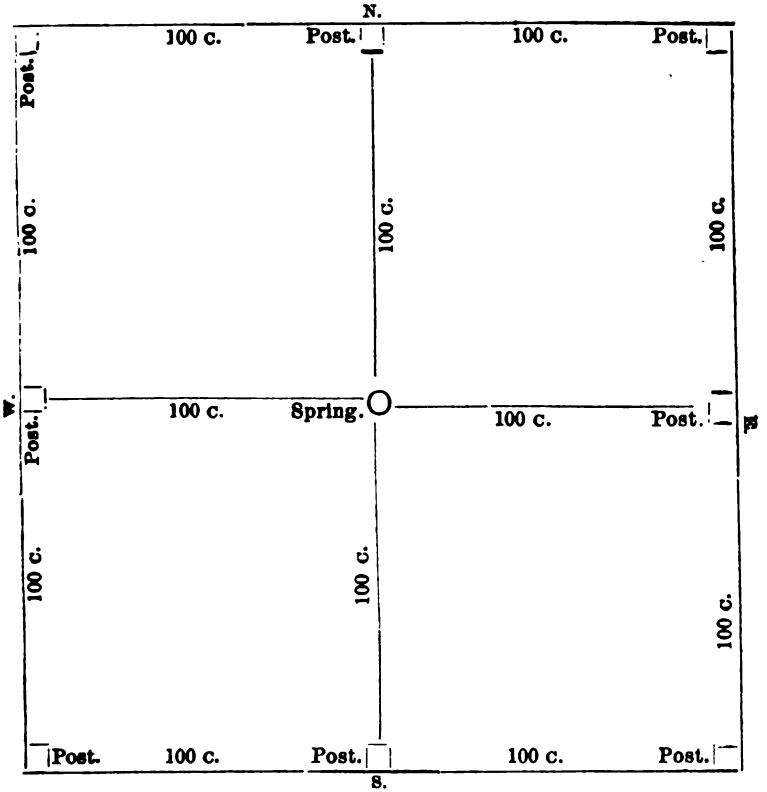
GENTLEMEN:—I have appointed you to select the lands of the State granted by the enabling act of Congress, approved February 26, 1857.

They consist of the following tracts:

First. Seventy-two sections of land for the use and support of the State University. * * *

Second. Ten sections of land, to be selected in legal subdivisions, "for the purpose of completing the public buildings, or for the erection of others at the seat of government." It is highly desirable, &c. * * * *

Third. Twelve salt springs, with six sections of land adjoining, or as contiguous as may be to each. On the discovery of a salt spring, you will proceed to identify the same as claimed by the State, in the following manner, to wit: By the establishment, as near as may be to the spring itself, of four substantial posts, firmly driven into and not less than three feet above the ground, in a direction corresponding to the cardinal points. Mark the same distinctly, (with a proper marking iron,) with the letters $\frac{SS}{M}$ then take the bearings, distance and size of at least two trees from each post so established, cutting from the same a good clear *blaze*, and marking thereon the letters $\frac{BT}{M}$ then proceed to mark out by means of blazed lines, running east, west, north and south, from the spring as a center, a piece of land as per figure. At a distance of about 100 chains from the spring, or center on such blazed lines, as also at the respective corners of the square, to be described or marked out, you will establish a post and take therefrom two bearings, all to be marked as before directed. Let your lines be well blazed and marked, so as to be plainly distinguished and observed by persons looking up land, and full notes kept of the bearings to the different posts set.



Whenever the land is of an open character, and bearing trees not to be obtained, you will establish your posts in mounds of stone, if convenient, otherwise of earth taken from a trench dug around the post, and covered with the sod taken therefrom; and it will be necessary where blazed lines, from the absence of timber, cannot be made, to mark such lines by means of either earth or stone, of a distance apart of not more than 20 chains.

You will also note a full description of quality and nature of the soil, timber, &c., of the land so marked out, together with any other natural objects that would be of value or importance, to be known in view of prospective settlement.

It will be desirable that the springs should be located as near as possible to some one or more known lakes, rivers or streams, with the distance or direction therefrom, so that they may be easily found, and their position shown on the map furnished you herewith, which has been prepared for the purpose of exhibiting the country lying between the line of the Government surveys and our national boundary, it being distinctly understood that all springs found situated within the lines of the Government surveys must be carefully connected therewith by giving the true course and distance to two or more of the section corners established on the same, so that they

EXECUTIVE OFFICE, 3d Sept., 1858,
ST. PAUL, Minnesota.

Hon. Joseph Rolette:

SIR:—I am informed you are aware of the existence of a salt spring in the vicinity of your residence within the boundaries of this State, and I desire that you should secure it with an amount of land equal to six sections adjoining it, as the property of the State. Congress, in the enabling act, granted to Minnesota (12) twelve Salt Springs, with six sections of land adjoining each.

On arriving at the spring in question, (here is quoted literally all on page 46 above) included between the brackets [thus].

You will please give the direction and distanee of the spring from the nearest known lakes or rivers or settlement, so that it may be easily found and its position shown on the map. You must be certain that the spring (or springs) is east of the Red river and south of the north line of this State.

You will forward all of your proceedings, sealed up, to me at this place, by mail or other safe conveyance, and you will be reasonably compensated for your labors.

Very respectfully yours,

HENRY H. SIBLEY.

P. S.—You will please communicate with Mr. N. W. Kittson before taking any steps to secure the spring as above, as he was requested to attend to the matter.

EXECUTIVE OFFICE, ST. PAUL, Minn.,
25th Sept., 1858.

Mr. Pierre Bottineau:

SIR:—You are hereby appointed a commissioner to select, in company with Mr. James D. Skinner, the lands to which the State is entitled under the enabling act of Congress. Your term will commence on the 27th instant, when you will proceed to join the party already dispatched and which you will probably fall in with at or near Breckenridge. On your arrival, Messrs. Johnson and Boyle will at once return to this place, as I have explained in my letter to them which you will deliver as soon as you come up with the party. The objects of the expedition have been made known to you by me, and fully embodied in the instructions to the gentlemen already sent out, and they will be communicated to you by Mr. Skinner. I depend much upon your experience and knowledge of the country, and have written Mr. Skinner that the party is to be guided by you in its movements, while Mr. S. will be particularly in charge of the surveys of the land, etc. You will be particular to progress as rapidly and to return as soon as possible.

Yours respectfully,

H. H. SIBLEY.

EXECUTIVE OFFICE,
ST. PAUL, MINN., 25 Sept., 1858.

Messrs. Skinner, Johnson and Boyle, Commissioners to Select Lands:

GENTLEMEN:—This will be handed you by Mr. Pierre Bottineau, whom I have engaged and dispatched to join the expedition and direct its course and movements, etc., directing the return and route of Messrs. Johnson and Boyle to St. Paul.

(*b.*) SALT SPRING LANDS SELECTED BY THE COMMISSIONERS.

The Commissioners appointed by the Governor to make selections of salt springs and lands for the State were Pierre Bottineau and James D. Skinner. Their report, attested by Wm. F. Wheeler, Notary Public of Ramsey County, and Wm. F. Wheeler, Private Secretary of the Governor, is recorded in the executive record (Journal A., p. 65,) under the date of 27 Nov., 1858, as follows, to wit:

STATE OF MINNESOTA,
COUNTY OF RAMSEY. } ss.

Before me, a Notary Public, in and for said county, personally came James D. Skinner and Pierre Bottineau, who being duly sworn according to law, did depose and say: That in the month of September last, (1858,) they were appointed by Henry H. Sibley, Gov-

ernor of the State of Minnesóta, commissioners on the part of said State, to select and mark out the twelve salt springs with the land adjoining, granted by act of Congress, approved March 3d, 1857, to the said State—that they have discharged the duty thus imposed upon them, and have found salt springs on or adjacent to the following described tracts or parcels of land included in the United States Government surveys, and which said tracts and parcels of land they have reported to the said Governor, as claimed for and in behalf of said State, under the act of Congress referred to, to wit: South half of section 23, south half of section 22, and sections 25, 26, 27, 34 and 35, in township 136 north, of range 45 west; sections 2, 3, 10 and 11, west half of section 1, west half of section 12, north half of section 14, north half of section 15, township 135, range 45; south half of section 20, south half of section 21, east half of section 30, east half of section 31, and sections 28, 29, 32 and 33, township 136, range 45; south half of section 19, south half of section 20, west half of section 28, and sections 30, 31, 32 and 29, and west half of section 33, township 136, range 44; sections 4, 5, 8, 9, east half of section 6, east half of section 7, and section 17, township 135, range 45; sections 12, 13, and north half of section 24, township 133, range 44, sections 1, 2, 11, 12, north half of section 13, north half of section 14, township 135, range 46; sections 7, 18 and west half of section 8, north half of section 19, west half of section 20, township 133, range 43; west half of section 6, west half of section 7, township 135, range 45; sections 7 and 18, township 131, range 42; sections 12, 13, east half of section 11, east half of section 14, township 131, range 43; west half of section 8, west half of section 17, township 131, range 42; section 6, and west half of section 5, township 131, range 42; west half of section 32 and section 31, in township 132, range 42; section 1 and section 2, township 131, range 43; section 35, township 132, range 43; also three salt springs outside of the lines of the Government surveys, with six sections of land to each, marked out by metes and bounds, and described as "eighteen sections of land, lying south from the Wild Rice river, and traversed by the south branch of the said Wild Rice river, which rises along the eastern boundary of said tract, and closely adjoining, and northwest from the crossing of the Red river trail, (so called.) At said branch posts were set and lines run out as per letter of instructions of the said Governor, and a map or diagram of which selections accompanies this affidavit, marked "A." And deponents further say that, according to the best of their knowledge and belief, no right to any of the said salt springs or lands claimed for the State as aforesaid, has vested in any individual or individuals by reason of prior claim or settlement or pre-emption, or by any grant from the Government of the United States. That they have visited in person and examined said salt springs, and that they do exist on or adjacent to the lands above designated, and are of the kind or description contemplated by the act of Congress above referred to. And the said deponents further say that they have delivered to the said Governor a general map of the country, which map or draft contains a designation of the particular location of the several salt springs so selected by them for the State as aforesaid, which correctly de-

scribes the location of the salt springs as they ar e marked on the said map or draft, and further deponents say not.

his
PIERRE ✕ BOTTINEAU,
mark.
JAMES D. SKINNER.

Attest:
W. F. WHEELER.

Sworn and subscribed before me this 27th day of November, 1858. Witness my hand and Notarial seal.

WM. F. WHEELER,
Notary Public,
Minnesota.

{ L. S. }

Attest:
WM. F. WHEELER, Private Secretary.

(c.) THE LOCATION AND EXISTENCE OF THE SALT SPRINGS.

Compilation of the Report of the Commissioners for the selection of Salt Springs for the State of Minnesota, under the Enabling Act (so called) of Congress, approved Feb. 26, 1857, so far as it relates to the location and existence of such Springs:

To His Excellency H. H. Sibley, Governor of the State of Minnesota:

The undersigned, Commissioners appointed by your Excellency to locate public lands for State purposes, beg leave respectfully to submit the following report:

* * * * * * * *

At Otter Tail City we obtained some valuable information from the Deputy Surveyor, to whom we delivered our letters from the Surveyor General's office. We learned from him the locality of two salt springs which he had discovered, and this information proved the means of our finding others. We also, through Mr. Bottineau's knowledge of the Chippewa language, derived important information from the Indians who were encamped at this point. This information proved to be of the greatest value in our explorations, and in no one instance did we find that the Indians misled us.

* * * * * * * *

After finally crossing the river, (Otter Tail,) the character of the country changed, the land rising into high bluffs, heavily timbered along the river, among which I noticed a large quantity of pine. The road here strikes through heavy timber, and leads for six miles, through a dense forest to *Lac Detroit*—so called from its peculiar conformation. Thence following the lake shore for a distance of three miles, we emerged again upon the prairie, over which we traveled until we reached *Eagle's Nest Lake*, about seven miles north of *Lac Detroit*.

At this point we diverged from the trail, and traveled westward until we struck the St. Cloud trail, leading, *via* Dayton, to Pembina; this we followed until we crossed the Buffalo river. Leaving the trail on the west side of this stream, we traveled westward across

the country until we reached a creek not laid down on any of the maps, but which subsequent explorations proved to be the south branch of Wild Rice river.

We were now in the vicinity of a salt region, descriptions of which had been given us by the Indians, and at once began a search for springs.

Following the creek last mentioned for about twelve miles we reached the crossing of the trail. There dividing the party, we instituted a thorough search, and soon discovered three salt springs, one and one-half miles distant, and bearing north-west from the crossing. These were so situated as each to carry with it its six sections of land, without interfering one with the other. Encamping here we prepared to make the necessary examinations and surveys.

These lakes we ascertained to have neither inlet nor outlet, and to be of a decidedly saline character. In every instance they were fed by springs situated near to and connected with the lake. These springs varied from six to thirty-six feet in diameter, and their waters were much more highly impregnated with salt than were those of the lakes which they fed, thus proving their distinctive character as salt springs.

The lakes themselves were from ten to thirty acres in area, as nearly as could be determined without actual measurement.

The soil around was the richest I had yet seen, being level prairie with a fine growth of grass, but entirely without timber, although four miles to the eastward extended a long ridge well wooded along its crest.

Beginning on the morning of October 15, I proceeded to lay out the land accompanying the springs as per letter of instructions from your Excellency, and closed up the survey on the evening of the 18th, having run in all about thirty-two miles of line. The manner in which the land is laid out will be seen by a diagram hereto annexed, marked "A."

* * * * * * * *

On this range (of bluffs) we once more struck the St. Cloud trail, which we followed southward until I found from the section posts, on the township lines, that we were near the springs described to us by the deputy surveyor. We then encamped on the ridge, which is here known as the Leaf Mountain.

The next day we discovered the springs referred to, and found them to be more abundant than we had supposed. We found here five distinct springs, of a highly saline character, and were able very advantageously to locate the lands to which the State is entitled. These springs lie in a level prairie, and are surrounded by salt marshes. In every instance, the springs lie considerably above the level of the adjoining soil. A saline deposit is found on their margins, and also on the surface of the ground adjacent.

* * * * * * * *

Leaving this locality, we returned to our camp on the ridge, near which we discovered another salt spring. The land around this consists of fine rolling prairie, and possesses the advantage of being

well timbered in part. This was surveyed, and we proceeded on our way, having thus far found nine springs with the lands attached.

Starting from this point on the morning of November 1st, we left the ridge, and, following the Red river road which runs at its foot, we crossed the Leaf Mountain, properly so called. Here the bluffs rise very high, some of them being three hundred feet above the ground level; passing beyond these, we traveled over a rolling country, well interspersed with lakes and timber, in which we discovered the tenth salt spring, which was a feeder to an adjoining salt lake.

The selections here were very desirable, being rich prairie with a sufficiency of good timber. The survey made, I proceeded with as great dispatch as the lateness of the season and the enfeebled condition of our animals—owing to the utter absence of proper food—would allow, to the large salt lake described to us by the Chippewa Indians. This lies about eight miles east of the crossing of the St. Cloud trail, at the town-site of Dayton, and is one of a long series of lakes. On our way thither we fortunately fell in with an Indian who had been one of a party engaged the previous winter in the manufacture of salt, at the lake. Under his guidance we reached the lake, and at once made the necessary examinations and surveys. The waters of this lake—which was of irregular shape, and some two miles in length—were strongly impregnated with salt, indeed more strongly impregnated than any I had yet tasted. The lake is fed by springs a little removed from and connected with it by a narrow channel. We here secured two springs, thus completing the number granted by act of Congress, and fulfilling all the objects of the expedition.

The selections here made were very valuable, being well supplied with good timber.

* * * * * * * *

(*d.*) THE SITUATION OF THE SALT SPRINGS, AND THE AREAS OF LAND APPERTAINING TO EACH.

Number of Spring.	LOCATION.	Area of selections in acres.
1	N. E. corner of N. E. ¼ of section 7, T. 131, R. 42	3,081.72
2	S. E. corner of S. E. ¼ of section 6, T. 131, R. 42	3,670.64
3	S. W. ¼ section 12, or N. W. ¼ section 13, T. 133, R. 44	3,760.52
4	Near center section 32, T. 136, R. 44	3,757.90
5	S. W. ¼ section 34, T. 136, R. 45	3,840.00
6	S. E. ¼ section 33, T. 136, R. 45	3,840.00
7	N. E. ¼ section 4, T. 135, R. 45	3,837.44
8	N. W. ¼ section 3, T. 135, R. 45	3,834.19
9	On range line bet. sec. 6, T. 135, R. 45, and sec. 1, T. 135, R. 47	3,645.03
10	In unsurveyed country on S. branch of Wild Rice river*.	About 4,000.00
11	" " " " " "	" 4,000.00
12	" " " " " "	" 4,000.00

* See diagram of the special survey by Commissioners, locating these lands in 1858, on file in the Governor's office, St. Paul.

(*e.*) CORRESPONDENCE OF GOV. SIBLEY.

EXECUTIVE OFFICE, 30th Nov., 1858,
ST. PAUL, Minnesota.

To the Register and Receiver of the U. S. Land Office at Otter Tail City:

GENTLEMEN:—You are aware that by the terms of the Enabling Act (so called) of Congress, this State is secured in the possession of twelve salt springs, with six sections of land "adjoining, or as contiguous as may be to each." Also, to "ten entire sections of land, to be selected by the Governor of said State, in legal subdivisions," for the purpose of completing the public buildings or for the erection of others at the seat of government. I dispatched commissioners on the part of the State to select these salt springs with the lands mentioned, and they have discharged their duty and reported to me. The lands indicated in the schedule herewith sent are those claimed for the State for the purposes above stated, and I have the honor to request that they may be noted as so claimed on the government surveys in your office, and reserved from pre-emption and sale. I have addressed a communication of this date to the Commissioner of the General Land Office on the same subject.

Very respectfully,
Your obedient servant,
HENRY H. SIBLEY.

EXECUTIVE OFFICE, Dec. 1, 1858.

Hon. A. P. Hendricks, Commissioner General Land Office, Washington City:

SIR:—I have the honor to state that I have this day addressed a communication to the Register and Receiver of the land office at Otter Tail, in this State, designating as nearly as possible the location of the twelve salt springs with the land adjoining or contiguous thereto, to which the State is entitled by the terms of the Enabling Act (so called) of Congress, approved Feb. 26, 1857.

* * * * * * * *

These salt springs and lands lie in the land districts respectively of the officers to whom the communications are made, and I have requested that the lands specified be reserved from pre-emption and sale, as they are claimed by me for the State. So soon as the formal report and accompanying map or diagrams can be prepared by the agents appointed by me to make the selections, I will transmit to you a copy of the latter, and meanwhile have the honor to request that you will instruct the several land officers to respect the selections made, and to mark upon the maps of the government surveys those portions of the lands claimed by the State as may be found within the lines of such surveys, and to designate also upon the permanent records of the offices such lands, so claimed, as are outside of such limits.

It will be found that these salt springs, with eighteen sections of land adjacent thereto, have been selected within the country as yet unceded by the Indian tribe to which it belongs, to the government, as it was necessary so to secure the whole of the twelve salt springs granted to the State. I am aware that the State cannot take possession of these before the extinguishment of the Indian title, but they can be so designated as to inure to the benefit of the State so soon as that event shall take place.

I am desirous to have all the questions connected with the selection of these salt springs and lands settled as soon as practicable, and it is with a view to a speedy consummation that I have the honor to request a reply, at your convenience, to the contents of this communication.

Very respectfully,
Your obedient servant,
HENRY H. SIBLEY.

To the above letter of Governor Sibley, the Commissioner of the General Land Office, at Washington, replied that a letter of instructions to the local officers at Otter Tail had been dispatched, requiring them to make such notes on their records as will clearly designate the lands selected, and to await further instructions. A copy of this letter was sent by Hon. J. S. Wilson to the Hon. Charles McIlrath, in a later correspondence, dated November 25, 1868, but it cannot be found in the records of the Auditor at St. Paul.*

(*f.*) CORRESPONDENCE OF AUDITOR M'ILRATH.

Gov. Sibley's term soon expiring, nothing further was done towards securing the title to these lands to the State, till the twentieth day of November, 1868, when the State Auditor addressed the Commissioner of the General Land Office a letter which received the following response. This, and the subsequent correspondence, will show the attempts made by the State Auditor to secure to the State of Minnesota the title to the lands originally selected by the commissioners under Governor Sibley.

Copy of a letter from Hon. J. S. Wilson, 89—419, Department of the Interior, General Land Office, Nov. 25, 1868:

Hon. Chas. McIlrath, Auditor and Land Commissioner, Saint Paul, Minnesota:

SIR:—I have to acknowledge yours of 20th instant, making inquiry about the selections of "salt spring lands" for the State of Minnesota.

In reply I state that on 1st December, 1858, the Governor of the State wrote to this office to the effect that he had written to the Otter Tail land office, designating as nearly as possible the location of the twelve salt springs, with the lands adjoining or contiguous thereto, to which the State is entitled by the terms of the Enabling

* It was forwarded by Auditor McIlrath to the land office at Alexandria.

Act (so called) of Congress, approved February 26, 1867. In reply thereto we addressed a letter of instructions to the local officers, at Otter Tail City, to make such notes on their records as will clearly designate the lands selected, and to await further instructions. I enclose a copy of this letter. No further action has been taken by the State authorities toward obtaining title to the lands, nor has this office issued any further instructions.

To bring the matter now properly before the Department, it is requested that the State will present, through the local officers, a list of the lands claimed for salt springs, with evidence of the existence of such springs, and if any other springs are still within an unsurveyed region, diagrams should be forwarded showing their locality by proper metes and bounds. When these are received we will be enabled to take definite action.

Very respectfully your obedient servent,

J. S. WILSON,
Commissioner.

STATE LAND OFFICE, ST. PAUL, MINN., March, 13, 1869.

Hon. Jas. S. Wilson, Com. General Land Office, Washington, D. C.:

SIR:—In compliance with the instructions contained in your letter of the 25th of November, 1858, ("89—419") relating to the selections of "salt spring lands" for the State of Minnesota, I herewith enclose the following papers, and respectfully request the action of the Department thereon, viz.:

1.—Copy of the affidavit of the commissioners who selected the said lands in 1858, certified to by the Governor and attested by the Secretary of said State, designating the lands by U. S. subdivisions where surveyed, and where not surveyed describing the same by metes and bounds.

2.—Map of the lands with field notes of surveys by said commissioners, showing positions of said springs in reference to the U. S. section corners.

I have also sent to the local land officers at Alexandria, the copy of the letter from your office to the officers at Otter Tail land office, dated December 14, 1858, requiring them to mark on their plats and tract books said salt spring lands, and accompanied the same by a similar list to the one herewith transmitted, and a diagram of the selections beyond the surveys.

Very respectfully your obedient servant,

CHAS. McILRATH,
Commissioner State Land Office.

Copies of the foregoing affidavits may be seen in the records of the land office at St. Paul.

STATE LAND OFFICE, ST. PAUL, MINN.,
March 30, 1869.

Register and Receiver of the United States Land Office, Alexandria, Minnesota:

SIR:—Herewith please find enclosed a copy of a letter from the General Land Office to the land officers of Otter Tail district, dated December 14, 1858, in relation to the State salt spring lands, also a list of said lands, and a diagram of selections beyond the surveys.

I have to respectfully request that you will examine your plats, and mark on them said lands, and file said diagram as presented in copy of letter referred to, and if in the change of the office from Otter Tail to St. Cloud and from thence to Alexandria, any of the lands have been entered, or the marks of selections obliterated on the plats, please let me know it.

Yours respectfully,
CHAS. McILRATH,
Com. State Land Office.

STATE OF MINNESOTA, AUDITOR'S OFFICE,
ST. PAUL, September 18, 1869.

Hon. L. K. Aaker, Register U. S. Land Office, Alexandria, Minn.:

SIR:—On the 30th of last March I sent to the Register and Receiver of the Alexandria office diagrams and lists of lands selected contiguous to salt springs by the State, under the Enabling Act; also a copy of a letter dated December 14, 1858, from the Commissioner of the General Land Office, "directing them to make such notes on their records as will clearly designate the lands selected," &c.; and requested that in case the change of the office from Otter Tail to St. Cloud, and from thence to Alexandria, had obliterated those notes or marks of selections on the plats or files of the office, they should re-mark them, and file the diagrams and lists of selections in the office as evidence of the compliance of the State with the terms of the grant. I also asked to be informed if any of the lands mentioned in the lists had been entered or applied for, under any of the acts of Congress for disposing of the public lands.

To that letter I have received no reply. I therefore desire to again call the attention of the office to this matter, and to respectfully ask that proper means be taken to set apart the lands mentioned in the diagrams and schedules referred to, to the State, for the purposes mentioned in the act, and that all settlement or entry of the lands be prohibited until the General Land Office has time to finally adjust the grant to the State; and if any of the lands have been entered or applied for under the laws of Congress, I wish you would send me a list of the descriptions and the dates when claimed, so that I may take the necessary steps to secure the interest of the State.

Respectfully yours,
CHARLES McILRATH

U. S. LAND OFFICE, ALEXANDRIA, MINN., September 28, 1869.

Chas. McIlrath, State Auditor:

DEAR SIR:—I have received your letter dated September 18, 1869, and will state in reply that I find the diagrams and lists of which you speak on file in this office, and also that the lands embraced in said lists and diagrams have been marked on the plats as desired. I am informed by the Receiver that a letter containing an abstract of said lands was transmitted to the Commissioner of the General Land Office, and also one to your office, but I can find no copy of any such letters, as there should have been if written.

I will, if desired, make out such an abstract and transmit it to your office as soon as possible, but we are at present engaged in making out our monthly returns.

Yours truly,
L. K. AAKER, Register.

GEOLOGICAL SURVEY.

In the course of the past season the work on the geological survey has been principally confined to the counties of Fillmore, Olmsted, Dodge and Steele. A detailed statement of the progress made will be found in the accompanying report of the State Geologist.

AGRICULTURAL COLLEGE AND FARM.

Instruction has been given during the past year both in the elementary and higher courses in agriculture, and an accession of about a hundred volumes has been made to the library of books relating to this department. The museum has received valuable additions in the shape of specimens of grains, seeds, grasses, preserved fruit, and lithographs of animals. In the orchard and nursery several hundred fruit trees have been planted, embracing numerous varieties of apples, cherries and plums. Several varieties of currants, blackberries, and other small fruit-bearing bushes have been set out in the fruit garden. The experiments made in the garden have been quite numerous, and embrace all the ordinary kinds of vegetables. A large number of experiments have also been made on the farm, upon different kinds of wheat, oats, corn, potatoes, beans, etc. The latter include the testing of thick and thin sowing and of a variety of fertilizers. That portion of the farm which was not devoted to experiments has been cultivated as usual, and has produced a considerable quantity of hay and grain. For full particulars as to the management of the agricultural college and farm you are respectfully referred to the accompanying report of the Professor of Agriculture.

RESOURCES OF THE UNIVERSITY.

The resources of the University consist of lands granted by Congress for the endowment of a university, and those granted to the State under the act of July 2d, 1862, donating lands for the benefit of agriculture and the mechanic arts.

Whole number of acres granted by Congress.....		202,000
Acres sold to pay debts.....	14,000	
Acres sold for permanent fund.....	38,626	
Acres unsold.....	149,374	
		202,000

PERMANENT UNIVERSITY FUND.

The permanent university fund is derived from the university lands sold by the State Land Commissioner, and from the sale of pine stumpage.

The amount of permanent fund at interest as per last report.	$201,712 00
Amount received from the sales of land for the year 1875....	25,632 98
Amount received from State Institution Fund.....	12,000 00
Amount received from sale of pine timber.....	7,303 80
Total productive fund.....	$246,648 78

CURRENT EXPENSES.

Receipts and disbursements for current expenses for the fiscal year ending Dec. 21st, 1875:

Receipts.

Amount received from State Treasurer to Dec. 21, 1875.....	$30,546 65

Disbursements.

For advertising.....	201 47	
For repairs.....	1,499 63	
For salaries of faculty.....	22,882 50	
For library and reading room.....	473 69	
For chemical laboratory.....	109 18	
For fuel.....	1,214 66	
For incidentals.....	3,588 15	
Deficit as per last report.....	8,654 64	
Balance.....		8,078 47
	$38,623 92	$38,625 12

GEOLOGICAL SURVEY.

Receipts.

Received from State Treasurer	$2,000 00

Disbursements.

Amount disbursed	$3,022 52	
Deficit as per last report	2,129 53	
Deficit for 1875		$3,152 05
	$5,152 05	$5,152 05

EXPERIMENTAL FARM FUND.

Amount on hand as per last annual report	$671 87

UNIVERSITY LAND FUND.

Amount on hand as per last annual report	$359 42

BUILDING ACCOUNT.

Receipts.

Amount disursed and on hand as per last annual report	$50,000 00
Amount received on State Auditor's warrants, 1875	18,000 00

Disbursements.

Amount disbursed as per last annual report	$46,447 56	
Amount disbursed since last report in 1875	16,763 76	
Balance on hand	4,788 68	
	$68,000 00	$68,000 00

HEATING AND FURNISHING ACCOUNT.

Receipts.

Amount on hand as per last annual report	$12,080 41
Amount received from State Treasurer in 1875	2,850 00

Disbursements.

Amount paid contractors, 1875.....	$4,530 90	
Balance on hand.....	10,399 51	
	$14,930 41	$14,930 41

Full information will be found in the accompanying report of the Treasurer.

GENERAL PROGRESS.

In addition to the particulars given above, the Board take pleasure in testifying that the past year has been one of unusual progress in all departments of the institution. The high character of the work done by the professors, and the increasing number of students of an advanced grade are unmistakable proofs of the realization of a prosperous university. Our facilities warrant an increasing patronage; and there is now no valid reason for students being sent to other States in order to secure the finest educational advantages.

We would, in conclusion, appeal to the friends of education in all sections of the State to aid our youth in their efforts to attain this free, higher instruction, which the University of Minnesota now offers, by making the town and city schools conform their courses, as far as possible, so as to prepare students for the University, and in this way make our school system complete, and a collegiate education accessable to all.

TREASURER'S REPORT.

PARIS GIBSON, TREASURER, IN ACCOUNT WITH THE BOARD OF REGENTS OF THE STATE UNIVERSITY OF MINNESOTA.

CURRENT EXPENSE.

1875.

Dr.

Jan.	5, To cash from State Treasurer		$2,000 00
Feb.	3, To cash from State Treasurer		541 65
March	16, To cash from State Treasurer		3,000 00
April	2, To cash from State Treasurer		3,000 00
"	19, To cash from State Treasurer		4,000 00
May	5, To cash from State Treasurer		3,000 00
June	29, To cash from State Treasurer		3,000 00
July	31, To cash from State Treasurer		3,000 00
Aug.	23, To cash from State Treasurer		2,000 00
Sept.	15, To cash from State Treasurer		2,000 00
"	29, To cash from incidentals		600 00
Dec.	1, To cash from State Treasurer		3,000 00
	To cash from sale of hay, University Land		5 00

Cr.

	By balance from report 1874			$8,654 64
1874.				
	By cash, repairs, Goodale	Voucher	1	439 81
Dec.	8, By cash, examination papers	"	7	2 50
"	19, By cash, repairs, hardware	"	10	207 15
"	19, By cash, repairs, paint	"	11	16 83
"	30, By cash, Harward's expenses	"	13	31 25
1875.				
Jan.	2, By cash, advertising, Farmer's Union	"	17	8 38
"	4, By cash, repairs, paint	"	20	21 60
"	5, By cash, repairs, painting	"	21	30 00
"	5, By cash, Wistar & Wales	"	22	40 10
"	5, By cash, library and reading room	"	23	8 10
"	9, By cash, engineer	"	27	45 00
"	19, By cash, papers and magazines	"	30	78 45
"	21, By cash, insurance	"	31	460 00
"	25, By cash, janitor	"	32	45 00
"	25, By cash, repairs, Perkins	"	33	97 54
"	25, By cash, stationery, Gaslin & Wales	"	34	49 07
"	26, By cash, repairs, paint	"	36	117 60

Jan.	29, By cash, repairs, lumber	Voucher	37	6 90
"	30, By cash, salaries for faculty, January	"	43	2,045 00
"	30, By cash, advertising, Farmer's Union	"	38	8 33
Feb.	1, By cash, library and reading room, Clarke	"	40	24 00
"	1, By cash, incidentals, Hildreth	"	49	3 00
"	2, By cash, Chemical Laboratory, book	"	50	5 20
"	6, By cash, dinner, Agricultural Association	"	55	50 00
"	9, By cash, engineer	"	62	45 00
"	20, By cash, library and reading room	"	64	15 00
"	20, By cash, house rent, President	"	65	250 00
"	24, By cash, Janitor	"	66	14 25
"	24, By cash, Janitor	"	67	36 00
"	27, By cash, advertising, Farmers' Union	"	69	8 33
"	27, By cash, Tribunes, extra	"	70	8 00
"	27, By cash, salaries for faculty, February	"	72	2,060 00
"	15, By cash, incidentals, Bickman	"	78	1 50
"	11, By cash, advertising, Citizen	"	77	37 50
"	16, By cash, fuel, Armstrong	"	80	204 11
"	17, By cash, insurance	"	81	300 00
March	1, By cash, insurance	"	86	100 00
"	3, By cash, printing, Johnson & Smith	"	90	35 00
"	4, By cash, fuel	"	92	7 00
"	4, By cash, library and reading room, Clarke	"	93	24 00
"	5, By cash, wood-cut and electrotype, Lowell	"	98	10 00
"	8, By cash, salary, Hutchinson	"	91	20 00
"	10, By cash, repairs, Bowman	"	99	25 99
"	10, By cash, engineer	"	100	45 00
"	20, By cash, salary Groff	"	102	60 00
"	24, By cash, incidentals	"	103	6 00
"	24, By cash, library and reading room, Clarke	"	106	18 00
"	24, By cash, janitor	"	107	51 05
"	26, By cash, salary, Hutchinson	"	108	7 50
"	26, By cash, incidentals, Newton	"	110	12 00
"	27, By cash, salary, Campbell, vice president	"	111	75 00
"	29, By cash, engineer	"	112	38 39
"	31, By cash, University Reports	"	115	20 00
"	31, By cash, salaries for faculty March	"	116	2,060 00
April	1, By cash, advertising, Farmer's Union	"	119	8 33
"	10, By cash, incidentals, Mahoney	"	125	11 80
"	27, By cash, library and reading room	"	133	6 40
"	30, By cash, salaries for faculty, April	"	137	2,115 00
May	1, By cash, incidentals, Cass	"	138	40 20
"	3, By cash, incidentals, Mahoney	"	140	40 00
"	3, By cash, library and reading room	"	141	36 00
"	5, By cash, incidentals, O. T Swett.	"	144	29 05
March	22, By cash, Harward's expenses	"	151	30 00
April	28, By cash, repairs, Bowman	"	152	20 82
May	1, By cash, advertising, Farmer's Union	"	153	8 33
"	5, By cash, incidentals, Mahoney	"	154	40 00
"	24, By cash, incidentals, Cass	"	155	38 00
June	5, By cash, library and reading room, Clarke	"	156	30 00
"	1, By cash, advertising, Farmer's Union	"	161	8 33
"	26, By cash, incidentals, Cass	"	165	82 20
"	26, By cash, incidentals, Cass	"	166	50 00
"	21, By cash, library and reading room, Clarke	"	168	18 00
"	21, By cash, incidentals, Mahoney	"	170	20 00
May	30, By cash, salaries for faculty, May	"	171	2,115 00
June	24, By cash, salaries for faculty, June	"	173	2,115 00
"	24, By cash, salary, Groff	"	175	60 00
"	30, By cash, incidentals, Bryant	"	176	12 00
July	1, By cash, advertising, Farmer's Union	"	177	8 33
"	9, By cash, Tribune, printing	"	182	54 36

July	10, By cash, repairs, Cronk	Voucher	187	12 50
"	12, By cash, transporting band	"	188	9 00
"	13, By cash, fuel, Armstrong	"	189	497 80
"	16, By cash, library nd reading room Clarke	"	192	11 60
"	23, By cash, incidentals, balance	"	195	54 49
"	26, By cash, repairs, Cronk	"	196	10 00
"	27, By cash, stationery	"	197	13 75
"	29, By cash, Dr. Hewitt's expenses	"	198	19 00
"	29, By cash, house rent, president	"	199	250 00
August	2, By cash, salary Prof. C. Y. Lacy	"	203	100 00
July	26 By cash, repairs, Pomeroy, Littlefield & Co	"	206	7 55
"	26, By cash, repairs, Pomeroy, Littlefield & Co	"	207	333 31
August	2, By cash, janitor	"	208	18 50
"	5, By cash, abstract	"	212	6 50
"	6, By cash, library and reading room	"	213	9 00
"	20, By cash, incidentals	"	217	50 00
"	23, By cash, incidentals, freight	"	218	4 70
"	23, By cash, incidentals, Cass	"	219	49 90
"	28, By cash, incidentals, Gaslin & Wales	"	222	31 75
"	30, By cash, library and reading room, Clarke	"	223	17 20
Sept.	1, By cash, salary, Prof. C. Y. Lacy	"	229	100 00
"	10, By cash, incidentals, printing	"	231	31 62
"	10, By cash, advertising, Citizen	"	232	24 00
"	10, By cash, advertising, Farmer's Union	"	233	16 66
"	15, By cash, repairs, Herzog	"	235	15 40
"	15, By cash, ncidentals Cass	"	236	57 75
"	16, By cash, salary Professor Marston	"	237	200 00
"	30, By cash, salaries for faculty, September	"	242	2,170 00
"	11, By cash, chemical laboratory, belting	"	246	17 14
"	24, By cash, brooms and dusters	"	249	20 25
"	24, By cash, library and reading room	"	250	12 80
"	27, By cash, incidentals, cleaning	"	252	93 60
Sept.	28, By cash, Pioneer Press Co.,	"	254	20 50
"	30, By cash, chemical laboratory, Hawes & Smith	"	260	4 20
"	30, By cash, chemical laboratory, Crash	"	261	3 13
Oct.	1, By cash, chemical laboratory	"	265	7 25
"	1, By cash, chemical laboratory, Raynor	"	266	9 64
"	1, By cash, library and reading room, Clarke	"	268	18 14
"	1, By cash, salary, Clark Stewart	"	272	50 00
"	5, By cash, incidentals, Mahoney	"	275	2 00
"	6, By cash, repairs, Pomeroy Littlefield & Co	"	277	28 00
"	4, By cash, printing Johnson & Smith	"	278	300 00
Sept.	25, By cash, printing, Johnson & Smith	"	279	150 00
Oct.	7, By cash, books, for different departments	"	281	400 00
"	1, By cash, salary, L. W Peck	"	286	100 00
Sept.	9, By cash, laboratory, Johnson & Smith	"	287	27 50
Oct.	6, By cash, incidentals, Bryant	"	290	52 45
"	18, By cash, incidentals, Johnson & Smith	"	293	8 00
"	23, By cash, museum	"	296	19 50
Sept.	9, By cash, fuel, Armstrong	"	297	6 25
Oct.	30, By cash, incidentals, Bryant	"	302	50 00
"	30, By cash, library and reading room, Clarke	"	303	30 00
"	30, By cash, library and reading room, Campbell	"	304	10 00
"	30, By cash, salary, Clark Stewart	"	305	30 00
"	30, By cash, salaries for faculty, Oct	"	306	2,270 00
Nov.	2, By cash, repairs, Peck	"	309	24 65
"	12, By cash, incidentals, Bryant	"	310	23 75
"	19, By cash, incidentals, Mahoney	"	314	25 00
"	19, By cash, library and reading room	"	316	30 00
"	20, By cash, salary, Clark Stewart	"	318	30 00
"	29, By cash, advertising, Anti-Monopolist	"	321	65 00
"	By cash, incidentals, Mahoney	"	324	46 00

Nov.	30, By cash, salaries for faculty, Nov....	Voucher	325		2,270 00
"	30, By cash, salary, Clark Stewart.....	"	326		80 00
"	30, By cash, incidentals, Bryant.....	"	329		50 00
"	30, By cash, library and reading room, Campbell.	"	330		10 00
"	30, By cash, library and reading room, Clarke ...	"	331		30 00
Dec.	4, By cash, incidentals, Geo. A. Wood.....	"	334		21 22
"	6, By cash, repairs, Chalmers & Co.....	"	338		29 50
"	6, By cash, chemical laboratory, chemicals.....	"	339		20 64
"	6, By cash, chemical laboratory, sundries.....	"	340		14 48
"	6, By cash, repairs, Bownan.....	"	343		19 38
"	8, By cash, salary, secretary, to Dec., 1875.....	"	345		100 00
"	8, By cash, salary, treasurer, to Jan., 1876.....	"	346		300 00
	By cash, dinner, May.....	"	347		12 50
	By cash, incidentals, Johnson & Smith.....	"	349		291 10
	By cash, incidentals, Mahoney.....	"	350		15 00
	By cash, salaries for faculty, Dec.....	"	354		2,300 00
Dec.	20, By cash, library and reading room, Campbell.	"	356		10 00
"	20, By cash, library and reading room, Clarke....	"	357		30 00
"	20, By cash, incidental, Bryant.....	"	358		50 00
"	20, By cash, fuel, Armstrong.....	"	360		500 00
				$31,146 65	$39,224 82
	Balance			8,078 17	
				$39,224 82	$39,224 82

BUILDING ACCOUNT.

Dr.

1875.			
	To balance from report, 1874.....		$3,552 44
July,	To cash.....		2,000 00
Oct.	2, To cash.....		3,000 00
"	18, To cash.....		8,000 00
Nov.	1. To cash.....		10,000 00

Cr.

1874.				
Oct.	16, By cash, paper under slate.....	Voucher	3	41 08
Nov.	27, By cash, O'Brien.....	"	5	500 00
Dec.	30, By cash, Long, architect	"	14	500 00
1875.				
Feb.	27, By cash, advertising	"	68	19 50
March	11, By cash, O'Brien.....	"	101	310 06
April	30, By cash, O'Brien.....	"	124	229 51
Jan.	12, By cash, O'Brien.....	"	129	750 00
April	23, By cash, O'Brien.....	"	132	210 00
"	29, By cash, O'Brien	"	134	2,175 78
"	30, By cash, O'Brien.....	"	135	750 00
May	5, By cash, Pickett.....	"	145	70 75
"	8, By cash, Goodale.....	"	146	300 00
"	8, By cash, Cullen.....	"	147	171 77
"	8, By cash, Cullen.....	"	148	700 00
"	27, By cash, Pickett.....	"	156	288 75
"	31, By cash, Cullen.....	"	157	350 00
June	5, By cash, Goodale.....	"	159	250 00
"	1, By cash, Slating	"	160	324 45
"	15, By cash, Cullen.....	"	162	583 00

July	2, By cash, Goodale	Voucher	178		550 00
"	2, By cash, Morgan & Co	"	179		78 40
"	3, By cash, Pickett	"	180		50 00
"	8, By cash, Goodale	"	181		20 63
"	12, By cash, Slating	"	183		61 10
"	22, By cash, Erkel	"	198		15 50
"	22, By cash, Donovan	"	194		24 50
"	31, By cash, Goodale	"	201		500 00
Aug.	2, By cash, Pickett	"	204		55 25
"	4, By cash, Pickett	"	209		140 50
"	10, By cash, Martin	"	216		63 00
"	28, By cash, Mahoney	"	221		35 90
Sept.	11, By cash, Goodale	"	234		384 49
"	16, By cash, Goodale	"	239		434 00
"	18, By cash, Donovan	"	240		78 75
"	19, By cash, Beckman	"	241		41 00
"	10, By cash, Erkel	"	244		78 00
"	10, By cash, Donovan	"	245		42 00
"	11, By cash, Malone	"	247		39 00
"	11, By cash, Pickett	"	248		20 00
"	25, By cash, Perkins	"	251		68 00
"	27, By cash, Seymour, Sabin & Co	"	253		60 95
Oct.	1, By cash, Malone	"	267		10 12
"	4, By cash, Goodale	"	274		500 00
"	6, By cash, Goodale	"	276		231 44
Aug.	25, By cash, O'Brien	"	282		411 30
June	24, By cash, Alden	"	283		200 00
Oct.	12, By cash, Long	"	288		200 00
April	15, By cash, Beck & Rank	"	296		500 00
Sept.	10, By cash, Beck & Rank	"	298		500 00
Oct.	25, By cash, Goodale	"	300		600 00
"	26, By cash, Long	"	308		200 00
Nov.	19, By cash, O'Brien	"	315		200 00
"	23, By cash, Beck & Rank	"	319		400 00
"	29, By cash, Goodale	"	322		209 99
"	29, By cash, Goodale	"	323		1,281 39
Dec.	6, By cash, Lumber	"	341		9 90
				$21,552 44	$16,763 76
	To balance				4,788 68
				$21,552 44	$21,552 44

GEOLOGICAL SURVEY.

DR.

1875.			
June	5, To cash	$2,000 00	

CR.

1875.					
	By balance from Report of 1874				$2,129 53
Jan.	30, By cash, Winchell	Voucher	42		200 00
Feb.	27, By cash, Winchell	"	71		200 00
March	2, By cash, taxidermist	"	75		10 00
"	17, By cash, Peck	"	82		169 85
"	23, By cash, Winchell	"	104		200 00
April	16, By cash, incidentals	"	131		16 07
"	30, By cash, Winchell	"	136		200 00

May	8, By cash, Hanson	Voucher	142			10 00
June	26, By cash, incidentals	"	168			12 50
"	26, By cash, Winchell	"	164			200 00
"	15, By cash, Howling	"	167			6 00
May	30, By cash, Winchell	"	172			200 00
June	24, By cash, Winchell	"	174			200 00
"	2, By cash, Winchell	"	205			20 00
August	5, By cash, Winchell	"	210			100 00
"	5, By cash, Winchell	"	211			200 00
Sept.	2, By cash, Winchell	"	280			200 00
"	30, By cash, Winchell	"	243			200 00
Oct.	15, By cash, Winchell	"	291			50 00
"	30, By cash, Winchell	"	307			200 00
Nov.	30, By cash, Winchell	"	327			200 00
Dec.	1, By cash, Winchell	"	333			28 10
"	20, By cash, Winchell	"	365			200 00
					$2,000 00	$5,152 05
	By balance				$3,152 05	
					$5,152 05	$5,152 05

HEATING AND FURNISHING.

DR.

1875.			
	To balance from report 1874		$12,080 41
Jan.	19, To cash		2,850 00

CR.

1874.					
Oct.	10, By cash, cement	Voucher	2		$61 00
"	29, By cash, hardware	"	4		5 00
Dec.	17, By cash, Stetson	"	8		18 82
"	18, By cash, Stetson	"	9		51 56
"	30, By cash, Peck	"	12		47 94
"	31, By cash, hardware	"	15		49 44
1875.					
Jan.	4, By cash, hydraulic ram	"	19		65 00
"	6, By cash, freight	"	24		24 50
"	7, By cash, Peck	"	25		95 60
"	8, By cash, freight	"	26		35 55
"	15, By cash, labor	"	28		6 00
"	18, By cash, Peck	"	29		270 57
"	25, By cash, hardware	"	35		131 59
1874.					
Dec.	28, By cash, balance Peckham's account	"	44		9 52
Nov.	19, By cash, Stetson	"	45		25 00
Dec.	18, By cash, Peck	"	46		3 90
1875.					
Jan.	2, By cash, freight	"	47		2 00
"	22, By cash, Stetson	"	48		9 31
Feb.	4, By cash, painting	"	51		22 58
"	6, By cash, sand paper	"	52		60
"	6, By cash, Peck	"	53		100 00
"	6, By cash, labor,	"	54		44 50
"	9, By cash, hardware	"	56		1 70
"	9, By cash, Wheaton & Reynolds	"	57		30 80
"	9, By cash, Stetson	"	58		1 52

Feb.	9, By cash, Talbert & White	Voucher	59	16 35
"	9, By cash, Wheaton & Reynolds	"	60	12 90
"	9, By cash, freight	"	61	3 95
"	15, By cash, hardware.	"	63	33 85
March	7, By cash, Peck	"	76	67 01
"	15, By cash, freight	"	79	7 95
Feb.	15, By cash, Peck	"	84	36 43
"	18, By cash, Perkins	"	85	11 25
March	2, By cash, Peck	"	87	54 36
"	2, By cash, Hanson	"	88	15 00
"	2, By cash, express	"	89	5 70
"	5, By cash, Bowman	"	94	13 41
"	6, By cash, Peck	"	95	7 15
"	8, By cash, Peck	"	96	9 41
"	8, By cash, Kouffel & Esser	"	97	123 69
"	23, By cash, Perkins	"	108	2 20
"	26, By cash, freight	"	109	3 40
"	30, By cash, sundries	"	113	70 48
"	31, By cash, Perkins	"	114	4 00
April	3, By cash, Perkins	"	121	29 68
"	6, By cash, freight	"	122	6 35
"	10, By cash, Savidge	"	123	9 20
"	10, By cash, Stetson	"	126	14 47
"	10, By cash, glass	"	127	11 87
"	10, By cash, hardware	"	128	20 06
May	5, By cash, labor	"	143	46 50
"	11, By cash, Peck	"	184	76 22
"	25, By cash, Perkins	"	185	16 85
June	8, By cash, Shirly	"	186	24 50
July	15, By cash, express.	"	191	1 75
"	31, By cash, preparing moose, Ward	"	200	109 78
Aug.	2. By cash, chemical laboratory	"	202	27 58
"	By cash, Benjamin	"	215	79 87
Sept.	26, By cash, Henry	"	255	4 40
"	30, By cash, wood	"	256	16 66
"	30, By cash, glass	"	257	2 40
"	30, By cash, Talbert & White	"	266	2 55
"	30, By cash, Spink	"	269	700 00
"	30, By cash, Wheaton & Reynolds	"	268	34 74
Oct.	1, By cash, Malone	"	268	16 50
"	1, By cash, Peck	"	264	21 90
"	1, By cash, Erkel	"	269	26 25
"	1, By cash, freight	"	270	11 10
August	9, By cash, casts of fossils, Ward	"	280	170 00
July	7, By cash, Benjamin	"	284	13 16
"	7, By cash, Benjamin	"	285	280 35
Oct.	12, By cash, casts of fossils, Ward	"	289	150 00
"	18, By cash, Perry	"	292	140 00
"	23, By cash, Pruden	"	294	170 00
"	25, By cash, Benjamin	"	299	115 97
Nov.	15, By cash, sundries	"	311	66 52
"	15, By cash, Peck	"	312	16 19
"	17, By cash, Barnard & Cope	"	313	168 33
"	20, By cash, Peck, bookshelves	"	317	150 00
Dec.	4, By cash, Peck, bookshelves	"	335	75 00
Nov.	2, By cash, J. W. Perkins	"	336	7 35
"	19, By cash, Erkel	"	337	9 75
Dec.	6, By cash, sundries	"	340	4 72
"	6, By cash, Bisbee & Co.	"	342	17 64
May	17, By cash, painting	"	348	4 00
Dec.	15, By cash, freight	"	351	60

Dec.	11, By cash, J. H. Woolsey & Co	Voucher	352		95 00
"	4, By cash, Benjamin	"	353		57 98
				$14,930 41	$4,530 90
	By balance				10,399 51
				$14,930 41	$14,930 41

EXPERIMENTAL FARM, ACCOUNT CURRENT.

DR.

To cash, hay	298 90	
To cash, vegetables	128 39	

CR.

	By balance from report 1874				235 07
1874.					
Dec.	By cash, hardware	Voucher	6		20 10
"	31, By cash, express and freight	"	16		7 00
1875.					
Jan.	2, By cash, Scott	"	18		50 00
Feb.	1, By cash, Scott	"	39		50 00
"	1, By cash, Budd & Wixom	"	41		8 00
March	1, By cash, Scott	"	78		50 00
"	2, By cash, labor	"	74		4 40
"	17, By cash, sundries	"	83		43 25
April	1, By cash, Scott	"	117		50 00
"	1, By cash, labor	"	116		10 95
"	3, By cash, Seeds, Ruble & Co	"	120		5 45
"	1, By cash, seeds, freight, &c	"	180		60 48
May	1, By cash, Scott	"	139		50 00
"	1, By cash, C. Y. Lacy's account	"	149		274 01
"	1, By cash, C. Y. Lacy's account	"	150		178 61
June	18, By cash, lumber	"	169		9 40
July	14, By cash, lumber	"	190		6 89
Aug.	10, By cash, C. Y. Lacy's account	"	214		395 53
"	29, By cash, Mahoney	"	220		21 85
"	28, By cash, Wixom	"	224		39 00
"	31, By cash, Scott	"	225		50 00
"	31, By cash, Budd	"	226		50 00
"	31, By cash, Mullory	"	227		10 00
"	31, By cash, Lawson	"	228		32 45
Sept.	16, By cash, Herzog	"	238		9 00
Oct.	1, By cash, Scott	"	271		50 00
"	2, By cash, Arnell & Christleib	"	273		4 35
"	30, By cash, Scott	"	301		50 00
July	31, By cash, Scott	"	320		150 00
Nov.	30, By cash, Scott	"	328		50 00
Dec.	1, By cash, Budd	"	332		4 10
"	8, By cash, Lacy's account	"	344		334 44
"	20, By cash, Scott	"	359		50 00
	By transfer to experimental farm fund account through error in last report				671 87
				$427 29	$3,069 20
	By balance			2,641 91	

EXPERIMENTAL FARM FUND.

To transfer from experimental farm fund account current through error in last report	$671 87

LAND SALES FUND.

To balance	$359 42

SUMMARY OF ACCOUNTS.

TREASURER DR.

To balance land sales fund	$359 42
To balance experimental farm fund	671 87
To balance building account	4,788 68
To balance heating and furnishing	10,399 51

TREASURER CR.

By balance current expense		$8,078 17
By balance geological survey		3,152 06
By balance experimental farm, current account		2,641 91
	$16,219 48	$13,872 13
To balance		2,347 35
	$16,219 48	$16,219 48

NINTH ANNUAL REPORT

OF THE

PRESIDENT

OF THE

UNIVERSITY OF MINNESOTA

TO

THE BOARD OF REGENTS.

1874-5.

SAINT PAUL:
THE PIONEER-PRESS COMPANY.
1875

THE UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, MINN.,
December 1st, 1875.

ent of the Board of Regents:

herewith to transmit the Ninth Annual
progress of the University.
e, Sir,
fully,
ur obedient servant,
WILLIAM W. FOLWELL,
President.



PRESIDENT OF THE UNIVERSITY.

To the Honorable the Board of Regents:

The University year 1874-5 began on the 15th day of September, 1874, and ended on the 24th day of June, 1875. I would respectfully refer you to the University Calendar, published soon after the close of the year, for the dates of the holidays, recesses and examinations, and the names and residences of the officers and students. In addition to the information commonly found in college catalogues, this issue of THE CALENDAR, being the first, contains the laws, state and national, which form the charter of the University, the by-laws enacted by you for the government of the institution, and also the names and residences of students in attendance previous to the year 1874-5.

THE WORK OF THE YEAR.

The accompanying tables [appendix A] show the work performed by the officers of instruction, so far as any statement of the kind can show it. No attempt is made to indicate the amount of time and labor spent by teachers in preparation for their classes, nor in scrutinizing and correcting examination papers, and rhetorical exercises. It ought to be noted that our modern methods of instruction and examination in college work, while they economize the time of the student, they add enormously to the labor of the teacher. For instance, a careful estimate shows that one member of our faculty during the past year was obliged to give the time of more than thirty school-days to the reading and marking of examination papers.

COMMENCEMENT.

At the third annual commencement, held in the new assembly hall, on the last day of the year, the following degrees were, upon recommendation of faculties, by your authority, conferred:

Bachelors in Arts.

ANDREW RUSSELL CASS, Ontario.
JULIUS ELLIOTT MINER, Goodhue county.
SIMON PETER STARRITT, Wright county.

Bachelors in Science.

SAMUEL ADDISON RANK, Fillmore county.
CLARK STEWART, Hennepin county.

Bachelors in Literature.

HELEN MAR ELY, Winona county.

Bachelors in Civil Engineering.

HENRY CLAY LEONARD, Fillmore county.
SAMUEL ADDISON RANK, Fillmore county.
CLARK STEWART, Hennepin county.

The excellent band of the 20th U. S. Infantry, led by Mr. Geo. Burt, was again detailed for service on this day by Maj. Gen. Sykes, commanding the Department of Dakota, who was represented by an officer of his staff, Lieutenant W. H. Ludlow.

A brief address delivered on this occasion is respectfully submitted for publication as part of this report.—[Appendix B.]

In the afternoon a Commencement dinner was partaken of at the Nicollet Hotel by the Regents, Faculty, Alumni and a large number of guests. Speeches were delivered by Rev. President Neill, of Macalester College; Hon. S. P. Jennison, Secretary of State; Rev. S. Y. McMaster, D. D.; Hon. Mark H. Dunnell, M. C.; Professor Levi Wright, Hon. Horace Austin, and others. The Students' Glee Club furnished a number of songs.

STUDENTS.

The number and classification of the students for the year (1874–5) are shown by the following tables:

I. SUMMARY (BY DEPARTMENTS.)

College or Department.	Class.	Gentlemen.	Ladies.	Total.
Science, Literature and the Arts..	Seniors	4	1	5
	Juniors	11	1	12
Mechanic Arts	Seniors	3		3
	Juniors	4		4
Agriculture, (Elementary Course).		2		2
Collegiate Department	First	17	4	21
	Second	36	9	45
	Third	38	14	52
	Fourth	57	22	79
	Special	7	7	14
Totals		179	58	237

II. SUMMARY (BY CLASSES.)

Seniors—of all Departments		8
Juniors—of all Departments		16
Sophomores—First Class, Collegiate Department		21
Freshmen—Second Class, Collegiate Department		45—90
Preparatory,	Third Class, Collegiate Department	52
	Fourth Class, Collegiate Department	79
Special, 14; Agricultural, 2		16
Total		237

III. COLLEGE OF SCIENCE, LITERATURE AND THE ARTS.

Class.	Course.	Gentlemen.	Ladies.	Total.
Senior	Classical	3		3
	Scientific	1		1
	Modern		1	1— 5
Junior	Classical	4		4
	Scientific	6	1	7
	Modern		1	1—12
Totals		14	3	17

IV. COLLEGE OF THE MECHANIC ARTS.

Class.	Course.	Gentlemen.	Ladies.	Total.
Senior	Civil Engineering..	3		3
Junior..	Civil Engineering..	3		3
	Architecture	1		1
Totals		7		7

V. COLLEGE OF AGRICULTURE.

Elementary Course, Gentlemen..... 2

VI. COLLEGIATE DEPARTMENT

Class.	Course.	Gentlemen.	Ladies.	Total.
FIRST	Classical	12		12
	Scientific	5		5
	Modern		4	4
		17	4	21
SECOND	Classical	11		11
	Scientific	22	4	26
	Modern	3	5	8
		36	9	45
THIRD	Classical	7		7
	Scientific	26	8	34
	Modern	5	6	11
		38	14	52
FOURTH	Classical	11		11
	Scientific	43	16	59
	Modern	3	6	9
		57	22	79
Special		7	7	14
Total		155	56	211

Two hundred and two (202) students were registered as residents of Minnesota, the following counties being represented:

Benton, 1; Brown, 1; Blue Earth, 6; Cass, 1; Carver, 1; Dakota, 4; Dodge, 1; Douglas, 2; Fillmore, 18; Freeborn, 1; Hennepin East, 49; Hennepin West, 47; Houston, 2; Kandiyohi, 1; Olmsted, 2; Le Sueur, 4; Meeker, 4; Mower, 1; Nicollet, 2; Ramsey, 5; Rice, 1; St. Louis, 3; Scott, 2; Sibley, 1; Sherburne, 1; Stearns, 2; Steele, 2; Wabasha, 10; Waseca, 2; Washington, 14; Winona, 4; Wright, 6.—33 counties.

Of the 96 students from Hennepin East and West, 23 came from the country, and 19 were temporary resident of Minneapolis.

Thirty-two (32) students were registered from other States and countries, as follows:

Canada, (Ontario), 2; Dakota Ter., 1; Indiana, 1; Illinois, 4; Iowa, 6; Maine, 3; Michigan, 2; Missouri, 1; Nova Scotia, 2; New York, 2; Ohio, 1; Pennsylvania, 1; Wisconsin, 6.

The employments or occupation of patrons were as follows:

Farmers, 105; Merchants, 22; Ministers, 19; Millers, 15; Attorneys, 11; Physicians, 6; Machinists, 5; Real Estate Agents, 5; Lumbermen, 4; College Professors, 4; Carpenters, 3; Mechanics, 3; Railway Men, 2; Book-keepers, 2, Laborers, 2: Builders, 2; Civil Engineers, Bankers, Painters, Jewelers, Blacksmiths, Traders, Accountants, Cabinet Makers, Manufacturers of Artificial Stone, Editors, Boarding House Keepers, Superintendents of Schools, Masons, Printers, Dentists, Nurses, Filers, Drovers, Mariners, Gardners, each, 1. Unknown, 6. Total, 237.

Seventy-four students engaged in some kind of remunerative employment, and 45 are believed to have earned their whole living. Seventy-five students had, at some time, been engaged in teaching.

The whole number of applicants for admission, during the year, was 116. Of this number 98 underwent examination, and 18 either failed to report or disappeared in the course of the examinations. Of the number (98) examined, 21 failed, 77 passed. The average per cents. of merits for the *Elementary Branches* were as follows: reading, 81; writing, 80; spelling, 91; arithmetic, 78; elementary Algebra, 52; English Grammar, 68; Geography, 74; United States history, 70; general average, 74.

Attention is respectfully called to the increased number (90) of students of full college rank in a year closing with the *third* annual commencement. It is gratifying to note also in the classes below an increased accession of students intending to pursue a full course of studies.

GENERAL PROGRESS.

I know of no better means of exhibiting the general progress of the institution than a comparison with the colleges and universities of the Northwestern States, a comparison which has been rendered possible only, by the published investigations of the National Bureau of Education. The figures given below are taken from the annual report of Commissioner John Eaton, Jr., for 1874. The institutions included are those of the states of the Mississippi Valley, lying north of the Ohio River, excepting institutions (twenty in number) under control of the Roman Catholic church, which are so peculiarly organized as not to admit of comparison. Separate agricultural colleges are also excluded for the reason that their grades, although bearing the same names as those of other colleges, do not generally correspond to them in scholarship.

TABLE I.

Showing the General Condition of Higher Education in the Northwest.

State.	No. of Colleges.	No. of Instructors.	No. of College Students.	No. of Preparatory Students.	Whole No. Students.	Average No. of Instructors.	Average No. College Students.	Average No. Preparatory Students	Average No. Students in all.	Average No. Students per Instructor.
Illinois	19	218	1,419	3,340	4,759	11⅓	75	176	250	22
Indiana	14	130	1,352	1,493	2,845	9	92	107	203	22
Iowa	17	178	829	2,703	3,532	10½	49	159	208	20
Kansas	5	26	126	355	481	5	25	71	96	18½
Michigan	7	103	817	801	1,618	15	117	114	231	16
Missouri	13	139	854	1,159	2,043	11	66	91⅓	157	15
Nebraska	3	18	55	190	245	6	18	63	82	14
Ohio	32	263	2,233	3,242	5,475	8	70	101	171	21
Wisconsin	8	90	644	1,097	1,741	11	80½	137	218	19
Totals	118	1,165	8,329	14,410	22 789	9.8	70½	120	193	19½

On comparing the final averages of this table with figures of this report the following notes may be made:

1.—The average number of college students in the 118 institutions is 71, against 90 as reported above.

2.—The average number of preparatory students is 120. We report 147.

3.—The average total attendance of the 118 colleges is 193; against a total of 237 as above.

4.—The average number of instructors is 10. The University of Minnesota employs 14, including a professor of Military Science, detailed as an army officer by the Secretary of War. The remaining excess above the average is of course due to the circumstance that the colleges of agriculture and the mechanic arts included in the University, demand additional specialists.

5 —The average number of students to each instructor is 19 ½. In this institution, there were, in the year 1874–5, 17 students to each instructor. The Michigan average is 16; that of Missouri, 15. This generalization, however, is of little account, since in organizing a faculty the number of teachers is determined by that of the departments to be opened and the branches to be taught rather than by the number of students expected to attend. A university must, in these days, fill its chairs with experts and specialists. Men of "general science" are generally useless in the class-room.

In connection with above a statement of the condition of the state universities of the Northwest will be of interest. The figures are derived from the same source. The Illinois Industrial University is chosen to represent that State, as in some sense the State University, and Oberlin College is selected from the Ohio list as one of the oldest, largest and best known of her colleges.

TABLE II.

A Statement Showing the Condition of the State Universities of the Northwest.

State.	Institution.	When organized.	No. of College Students.	No. of Preparatory Students.	Whole No. of Students.	No. of Instructors (resident.)	No. of Students to each Instructor.
Indiana	State University	1828	155	90	245	12	21
Ohio	Oberlin College	1834	215	258	473	20	24
Missouri	University of	1840	181	216	397	31	16
Michigan	University of	1841			476	31	15
Wisconsin	University of	1848	245	128	373	21	18
Iowa	State University	1860	126	228	354	19	19
Kansas	University of	1865	59	115	174	18	17
Illinois	Industrial University	1867	2	2	406	25	16
Minnesota	University of, *	1868	71	212	287	13	22
Nebraska	University of	1871	43	57	100	8	12½

* Report of 1873-4.

This table might be submitted without remark, but that justice to our own university seems to call for a statement of the fact, that according to the high standard of scholarship which we are endeavoring to maintain, a large proportion of students reported by some of the universities would be transferred to the column of preparatory students. It is the fact that in certain of these institutions pupils who pass examinations in the common school branches only, are enrolled as Freshmen and are graduated in four years. Were we to admit and classify according to this rule the whole number of our students might be entered as college students. There can be no doubt but that it is the part of wisdom to adhere to the sound policy of keeping up to the established standard of scholarship. This policy will of course diminish the number of graduations, but it must be remembered that it is the quality, not the number of graduates which will bring honor to the University and credit to the State.

Year (ending.)	No. of Instructors	No. of College Students.	No. of Preparatory Students.	Total Students.	Remarks.
1868.	3		72	72	
1869.....	5		146	146	University Faculty organized.
1870.....	9	18	194	212	
1871	9	24	201	245	
1872	12	27	238	265	New courses of study
1873.....	13	47	231	278	
1874.....	13	75	212	287	
1875.....	14	90	147	237	Lowest year dropped.
1876.....	14	102	153	255	First term only.

Before passing from this topic I desire to call attention to an incidental but very important consideration. It appears on summing up the columns of Table I, that 118 northwestern colleges, manned by 1,167 resident instructors, instruct 8,329 proper college students, and 14,410 preparatory Students; in all 22,739 students. The average attendance at each college is 71 college students and 120 preparatory students—total, 193 students. In other words these colleges report themselves as teaching 36 6-10 per cent. of their students in the proper college studies, and the remaining 63 4-10 per cent. in studies not belonging to colleges to teach, but to preparatory schools. I say these colleges so report themselves: my belief is that, judged according, that just and reasonable standard of scholarship, to which we endeavor to adhere, not more than 25 per cent. of these 22,739 would fairly attain college rank, say 5,700, giving an average of less than 50, (48), to each institution. If this estimate is correct, the remaining 17,039 students, (145 to each college,) are receiving their preliminary education in a way very costly to the colleges and to the people.

The conclusions to be drawn are obvious:

(1.) The number of colleges is excessive; there are not enough proper college students in all the 118 colleges to give twenty colleges an average attendance of 300 men.

(2.) There is a lack of secondary schools all over the territory embraced. Only 8 of the 118 colleges and universities, (a trifle

over 6 per cent.,) of the nine states reports no preparatory students. The colleges of Illinois, Indiana, Nebraska and Wisconsin, without exception, reports preparatory students. Four out of the 32 Ohio colleges only do not. Of the remaining States, Iowa, Kansas, Michigan and Missouri, but one college in each report no preparatory students. Of all the state universities, (see Table II.) that of Michigan alone has rid herself of the burden of fitting her own candidates for admission.

(3.) The third conclusion is that those states which have organized state universities, regardless of the need of secondary schools to furnish suitably prepared students, have still before them the inevitable task of filling up the gap or chasm in their systems of public education between the University and the common school. This subject, so far as it concerns our own State, I have had the honor of presenting in previous reports, and therefore refrain from its further discussion. I will only reiterate the fact, which will be apparent to all who will investigate or even reflect upon the subject, that before there can be a great University in Minnesota, there must be a large number of secondary schools to fit young men and young women to do the work of the University. Such schools must in some sense be public, and belong to the general system of public instruction, no matter by whom owned or operated, and it is the part of the State to organize the secondary as well as the primary and the superior education. I strongly favor assisting private academies, under proper conditions and restrictions.

The foregoing discussion of the condition of higher education in the Northwestern States will, I trust, be found of use whenever the Board are called upon to consider the question of dropping off additional instalments of preparatory work. If the example and experience of the whole body of colleges in neighboring States are to be taken as a guide and standard, the past action of this Board will need no apology nor justification. In regard to the matter of dispensing with a second preparatory year, I beg leave to quote the following, used in the annual report to the State Superintendent for 1875:

"The requisites for admission to the lowest class or grade of the collegiate department will remain the same as hitherto for and during the next University year, 1875-6 only. At the close of that year the instruction of the Fourth class will, by virtue of a resolution of the Board of Regents, be formally discontinued, and the branches and subjects of the said class will be added to the requirements for admission. The lowest class then remaining will be the third, or sub-Freshman, full standing in which can only be secured by passing satisfactory examinations, as follows:

"(1) *All applicants* will be examined in
Reading, Writing and Spelling;
English Grammar, (including Analysis,)
Arithmetic, complete,
Algebra, through quadratic Equations.
English Composition and Rhetoric,
Outlines of General History.

"(2) All applicants who desire to pursue the Latin Language, in any of the courses of study, will be examined in the Latin Grammar and Reader, and Part I. of Latin Composition.

"(3) Applicants for admission to the CLASSICAL COURSE, will be further examined in

Cæsar's Commentaries, (four books,)
Cicero, (First oration.)
Greek Grammar and Reader,
Xenophon's Anabasis, (3 chapters of Book I.)

"(4) Applicants for admission to the SCIENTIFIC COURSE will be further examined in

Physical Geography,
Natural Philosophy,
Physiology,
Free Hand Drawing,
History of England,
Study of English words,
Elementary Astronomy; but in lieu of the last three studies in the English language, applicants may offer either the Latin or the Greek of the classical requirements.

"(5) Applicants for admission to the MODERN COURSE will be examined in

History of England,
Higher English Grammar,
Physiology, and in the
Latin or Greek required for the classical course; but applicants may offer in lieu of this Latin or Greek, the following scientific studies:

Physical Geography,
Natural Philosophy,
Elementary Astronomy.

"The amount and kind of preparation thus indicated can be furnished without difficulty by several of the High and Graded schools of the State. By some, however, the whole of it cannot be given, and of the common schools we can only expect that the more elementary subjects will be taught. Inasmuch as the majority of our students come from the country districts, with only the preparation of the common schools, the question, 'How shall the sons and daughters of farmers, and other country residents, be fitted to enter the University?' remains as important and vexatious as ever.

"The institution stands in this dilemma: If all of the preparatory work included in the foregoing list be abruptly abolished the country patrons may complain that there is no place to which they are entitled to send their students to be prepared for admission; if, on the other hand, the University shall continue too long to offer this preparatory instruction, then the city schools may complain of interference with their functions.

"What the action of the Board of Regents may be, cannot now be known, but I do not deem it improper to lay before you a plan which has been suggested, as a possible solution of the problem. Its points are:

"(1) That the 'Fourth Class' be dropped in accordance with the resolution now on record; but

"(2) That the Board of Regents retain the privilege of organizing auxiliary classes for instructing students who may be found insufficiently prepared in certain branches; such, for instance, as the elements of Latin and Greek, Algebra, English language and General History, but.

"(3) That this instruction be offered only to such students as may be unable to obtain it in the public schools of the school districts in which they reside.

"Such an arrangement, it is thought, would keep the work of the University in actual articulation with that of the schools of the State without danger of drawing away from the high and graded schools the pupils who can therein obtain their preparatory instruction. This equitable discrimination in favor of the rural applicants might perhaps be extended still further, so as to close the University to city students of any grade who can carry on their studies in the high schools, until such time as provision may be made for admitting country students to the high schools. This subject is respectfully urged upon your attention."

It will be observed that the above suggestions presume that the Board will adhere to their resolution to drop the Fourth Class at the close of the current year, and that the suggestions relate to a state of things which would thereupon ensue. The requisites for admission might, in my opinion, be considerably simplified by two or three omissions and some changes in distribution.

THE LIBRARY.

The additions during the year have been but few. The amount expended in purchasing books, as shown by the Treasurer's report, is $354.58. The public documents of the general government have been sent mostly by Senator Ramsey, but some of them by heads of Departments. Much pains will be taken to collect and preserve complete files of these documents. Many of the older ones have become scarce and valuable, and can only be had of second-hand book dealers An effort will be made likewise to obtain complete sets of our State public documents. I would respectfully recommend the appropriation of $100 or so much thereof as may be necessary, to purchase a complete set of the State statutes.

Appendices C, D and E show the donations of the year, the number and kind of books drawn by students, and the reviews and journals supplied to the reading room. The usual appropriation for the reading room and binding is respectfully requested.

Appendix F is a list of printed books added to the Library since the last report, which was completed up to December, 1874. This list, embracing the Tappan collection, is necessarily an extensive

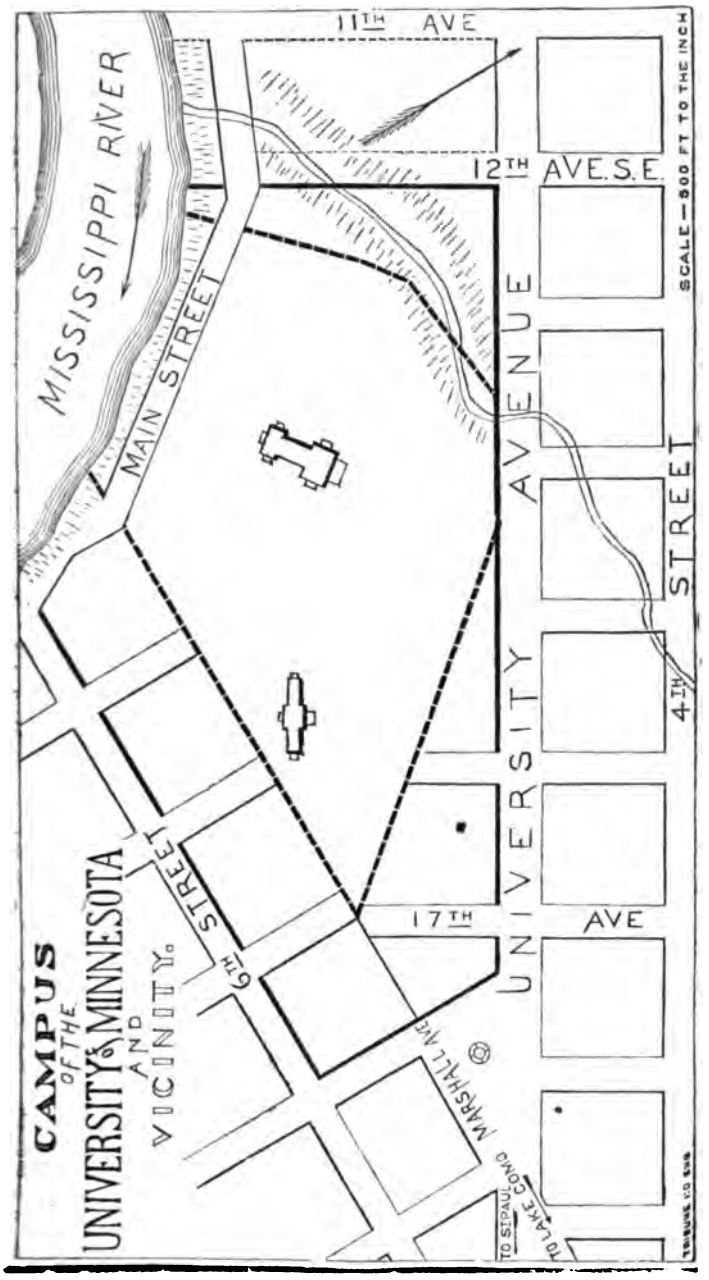
one. Should objection be made to printing this list, it might be represented that there is no other means by which the Legislature and the people can judge of the manner in which the public funds have been used. A library is always a costly establishment, and a library without a printed catalogue is as good as useless to all except the few persons who have the leisure to acquire personal familiarity with the works as they stand on the shelves. From printed lists any citizen can in a very short time ascertain what works this institution possesses. The library thus becomes known to the whole State, and becomes in fact as well as in theory accessible to all. I respectfully renew my recommendation that the annual appropriation for the library, now fixed at $500, be raised to at least $2,000.

BUILDINGS.

Since the close of the period covered by this report the new buildings have been so far completed as to be partially occupied, but as much remains to be done, any elaborate descriptive report is necessarily postponed till another year. I would respectfully recommend that the second story of the Agricultural College be finished up as soon as possible, as the rooms will be much needed.

THE GROUNDS.

So soon as the new buildings shall have been finished up and all rubbish removed, some reasonable outlay should be made upon these grounds. No great expense need be at once incurred, inasmuch as no suitable system of improvement and decoration can be carried out until the institution shall have come into possession of certain adjoining property. To show the shape and environment of the grounds, and the need of the proposed additions, the accompanying map, prepared by Professor Rhame, is submitted. The heavy dotted line shows the old or present boundary of the campus, and the heavy black line the proposed new boundary. Unless a suitable area, both as to size and surroundings, can thus be secured, the institution ought to be removed to a more favorable site. No private lots should abut against a college campus.


CAMPUS
OF THE
UNIVERSITY OF MINNESOTA
AND
VICINITY.
MISSISSIPPI RIVER
MAIN STREET
11TH AVE
12TH AVE. S.E.
UNIVERSITY AVENUE
4TH STREET
17TH AVE
6TH STREET
MARSHALL AVE
TO ST PAUL
TO LAKE COMO
SCALE—500 FT TO THE INCH

APPARATUS.

The additions to the apparatus have been large and valuable. Indeed, it should be said that hitherto the institution has had no "outfit" in this respect. The new chemical laboratory, although inferior in size, will be equal in point of equipment to any in the West. Much credit is due not only to the ingenuity but to the energy of the professor, who gave nearly the whole of his summer vacation, without compensation, to fitting up this laboratory.

The supply of physical, engineering, and mineralogical apparatus fairly suffice for present demands. It ought to be remembered that to keep pace with the advancement of the sciences and the probable growth of the institution, that not less than one thousand dollars a year must be spent upon apparatus and instruments.

GEOLOGICAL AND NATURAL HISTORY SURVEY.

The geological portion proper of this enterprise I judge to be making commendable progress. The chemical investigations, for a long time past held in abeyance, awaiting the completion of the laboratory, can now be vigorously prosecuted. I venture to renew a suggestion offered in the last report, that the botanical and entomological departments of the survey should at once be taken in hand. To this end a professor of botany and entomology must be employed. The topographical work may progress slowly for a few years, but steady preparations should be going on for extensive and thorough work when the proper time shall arrive.

The museum, of which the professor of geology is curator, has received very considerable accessions, among which may be mentioned a full collection of Ward's Casts of Celebrated Fossils, secured through the liberality of citizens of Minneopolis.

COLLEGE OF AGRICULTURE.

This department is still slow in development, and no means have been taken in this institution to make a factitious showing of it. It is the fact that, as yet, our farmers' sons and daughters, who constitute nearly one-half of our student body, come to us preferring to pursue general scientific and literary studies, rather than such as relate directly to agriculture. Two young men form the only exceptions to this statement during the year covered by this report, one of whom left before the close of the year. Both were in the elementary course.

The operations of the Experimental Farm are fully described in the accompanying report of Assistant Professor Lacy. The annual meeting of the State Agricultural Society convened at the University in February, and the summer meeting of the State Horticultural Society in June. There is reason to hope that these societies will hereafter frequently meet at the University. The suggestions of Professor Lacy in regard to the size, location, and general suitability of the present experimental farm, seem to be worthy of serious consideration.

COLLEGE OF MECHANIC ARTS.

This department seems to offer greater attractions than that just named. As already shown, there were seven young men on the rolls, two of whom were graduated as Bachelors of Civil Engineering at the Commencement. One other gentleman, Mr. Clarke Stewart, a member of the College of Science, Literature and the Arts, having completed the course in civil engineering, received the same degree. It should be remarked that students do not enter this department until Junior year, or a much larger number of names could be reported. Along with the rapid development of manufactures and transportation, and the growth of our cities, there must be a steadily increasing demand for engineers, both civil and mechanical, and for architects. Accordingly this college of the University ought to be so well equipped and efficiently manned as to allow of no excuse for young men adopting the professions indicated to go out of the State for their technical education. Among the appliances most needed at present is a small steam engine of sufficient power to drive a lathe, a drill, and a planer. While the engine would serve excellently as a piece of apparatus for instruction, it would enable the professors and students to manufacture many articles of apparatus, which would otherwise have to be purchased at high prices. The sum of five hundred dollars would be sufficient to pay for the engine, to set it up and supply the necessary connections and shafting. Steam can be taken from one of the boilers of the heating apparatus.

NEW DEPARTMENTS.

Many inquiries reach me in the course of correspondence in regard to departments not yet organized. Some of these relate to medicine, but the greater part to law, and nearly all appear to come from uneducated young men, who desire to enter upon a course of professional studies, without scientific and literary preparation. Whether the State ought to establish and support expensive law and medical colleges, for the instruction of such candidates, is a question which, perhaps fortunately, need not be argued, inasmuch as the present income at the disposal of the Board does not warrant the opening of new departments. I trust, however, that not many years will pass before it shall be possible to open a law department, of such character as a public-endowed institution alone can open. This department can be organized at a comparatively small outlay, and if necessary could be made nearly self-supporting.

NEW PROFESSORSHIPS.

Reference has been already made to the pressing need of a professor of Botany and Entomology. Hardly less pressing is the need of a full professor in the department of Physics. The professor of Chemistry, now in nominal charge of Physics, cannot possibly give instruction in the two subjects. The science of Physics has received

an immense development of late years. It is the science of the steam engine, the electric telegraph, of the modern optical and astronomical apparatus, of heating, lighting and ventilation, and of all the great natural processes and transformations. No university can long postpone the complete and independent establishment of the Chair of Physics.

SECRET SOCIETIES.

I deem it a matter of duty to apprise the Board, that just before the close of the previous year, one of the student societies of the country, frequently spoken of as "Greek Letter Societies," had established a so-called "Chapter" in the University. Inasmuch as these organizations are tolerated in most of the older American colleges, the General Faculty have not deemed it necessary to interfere with the one appearing here. While I might therefore be excused from further reference to the subject, I feel that I should do less than my duty, if I did not at this time express my extreme regret at the formation of this chapter, and briefly add my opinion of all such societies. While I have been connected with one of the most reputable of them, I think myself bound to say that they are not only unnecessary, but they are sometimes positively vicious and injurious in their influence. Among the objections which, irrespective of the general charge of useiessness, might be urged against these societies, are the following:

(1) They are frequently injurious to the authorized literary societies of the college. This fact is already apparent here.

(2) They create jealousy and unfriendliness, by dividing the classes and student body into permanent cliques, defending and upholding their members, irrespective of merit or right.

(3) They are costly, both of time and money.

(4) They occasion expensive conviviality, and have been known to lead to dissipation.

(5) They furnish ready and convenient organizations for obstructing the college discipline.

(6) They are peculiarly inappropriate in a free public institution open to both sexes.

These considerations I respectfully submit, to be estimated at their proper value, without offering any proposition or plan of action. It is a fair question for consideration, whether it were better at once to prohibit the existence of secret societies among our students, and to enforce the prohibition by whatever measures might be necessary, or to let them alone, trusting to the good sense of their members to render them, for the present, as little obnoxious and mischievous as possible, and to the spread of a public sentiment, already powerful in some of the greater colleges, to work their ultimate extinction.

With our new buildings, apparatus, and appliances, the University enters, at the opening of a new year, upon a new era The institution will stand fairly on college ground. The number of college students proper will be above the average of that American colleges. Thanks to the liberal provisions of the Legislature, we can

already offer to the youth of Minnesota advantages and facilities superior to those of most colleges of the country. It is however to be remembered that we are competing not with the average colleges, but with the best. A journey of a few hours sets a Minnesota boy down at the doors of the oldest and richest of American universities. There is no help for it, but that a new university, if it expects to grow, must offer all the essential advantages of a university. This requires large outlays. Unless there is a sure prospect of a great revenue it is questionable whether a new college should go into operation at all. Especially should there be caution about attempting the work of a university. This institution, but for causes apparently beyond the control of this Board, and perhaps of this generation, might have possessed an endowment of magnificent proportions. I would earnestly submit as the gravest subject for the consideration of the Board, the question: May it not yet be possible, through liberal and enlightened legislation, not compromising other interests, to provide for the University such an endowment as will ensure its perpetuity and prosperity and hand it down as a blessing, not a burden to the future?

All of which is respectfully submitted.

APPENDIX A.

A Tabular Statement of the amounts and kinds of work performed in the various departments of instruction of the University of Minnesota in the year 1874-5, exclusive of the examinations and the revision and correction of papers.

Subjects.	Instructor.	Class.	No. of Exercises	No. of Students.	Term.
MATHEMATICS.					
Algebra	Thompson.	Fourth.	50	64	I.
Algebra, advanced	"(H.S G.)	Third.	55	40	III.
Plane Geometry	" "	Third.	68	41	I.
Solid Geometry	"	Second.	12	40	II.
Plane Trigonometry	"	"	44	40	I.
Spherical Trigonometry	"	"	44	40	I.
Conic Sections	"	"	80	26	III.
Analytical Geometry	"	First.	52	21	I.
Surveying	Peck.	Second.	40	27	III.
Differential Calculus	Thompson.	Junior.	61	10	I.
Integral Calculus	"	"	50	7	II
Modern Geometry	"	"	30	6	III.
Gen. Theory of Equations	"	"	20	6	III.
Elementary Astronomy	"	Fourth.	50	9	III.
Descriptive Astronomy.	"	First.	50	28	II.
Practical Astronomy	"	Senior.	40	3	I.
CHEMISTRY.					
General Chemistry	Peckham.	Second.	55	35	II.
Applied Chemistry	"	"	54	17	III.
PHYSICS.					
Molecular Physics	Peckham.	Second.	64	40	I.
Mechanical Physics	Rhame.	First.	65	9	I.
Natural Philosophy	Peckham.	Fourth.	55	52	II.
GEOLOGY, &c.					
Historical Geology	Winchell.	Junior.	26	12	II.
Historical Geology, lectures	"	"	14	12	II.
Dynamical Geology	"	Third.	55	56	II.
Mineralogy	"	Junior.	43	12	III.
Blowpipe Analysis	"	"	42	8	III.
BOTANY.					
Structural Botany	Winchell.	Third.	28	33	III.
Systematic Botany	"	"	28	27	III.
ZOOLOGY.	Lacy.	First.	50	13	III.
PHYSICAL GEOGRAPHY.	Peckham.	Third, Fourth	63	66	III.

Subjects.	Instructor.	Class.	No. of Exercises	No. of Students.	Term.
ENGLISH, &C.					
Elements of Criticism	**Marston.**	**Senior.**	**55**	**8**	**I.**
Elocution.	"	"	10	7	I.
Constitution, United States	"	"	50	7	II.
Constitution, Minnesota	"	"	5	7	II.
Rhetorical Exercises	"	"	49	7	I, II, III.
English Literature	"	**Junior.**	**65**	**15**	**I.**
English Literature	"	"	22	6	II.
English Literature	"	"	22	6	III.
Rhetorical Exercises	"	"	117	13	I, II, III.
Logic	"	**First.**	**55**	**23**	**I.**
Rhetoric	"	"	50	18	III.
Rhetorical Exercises	"	"	19	23	I, II.
Rehearsals	"	**4 Upper.**	**350**	**74**	**I, II, III.**
Essays, &c., criticised	"	"	280	74	I, II III.
Prose Composition	**Laing.**	**Fourth.**	**64**	**61**	**I.**
English Philology	"	Second.	64	13	I.
Modern History	"	Third.	113	10	II, III.
Modern History, Lectures	"	"	11	10	II, III.
General History	"	**Fourth.**	**55**	**32**	**III.**
General History, Lectures	"	Third.	83	28	III.
Higher English Grammar	"	Fourth.	58	28	II.
Elocution, Lectures	"	2d, 3d & 4th.	43	143	I, II, III.
Rhetorical Exercises	"	"	785	143	"
Rehearsals	"	"	525	"	"
Essays, &c., criticised	"	"	630	"	"
Hadley's "Brief History"	**Folwell.**	**Jun.**	**30**	**3**	**I.**
GERMAN.					
German Grammar	**Moore.**	**Jun. & 3d.**	**66**	**95**	**I.**
Iphigenie and History	"	Third, § 1.	66	18	I.
Iphigenie and History	"	Third § 2.	66	17	I.
Piccolomini and Lager	"	2d & Jun.	66	17	I.
Grammar and Reading	"	Jun. & 3d.	57	18	II.
Jungfrau von Orleans	"	Third.	57	20	"
Wallenstein's Tod	"	Second.	57	14	"
Nathan der Weise	"	Sen. & Jun.	35	9	"
Herman and Dorothea	"	Second.	55	14	III.
Undine	"	Third.	55	16	"
Andersen's Mærchen	"	Jun. & Third.	55	14	"
Goethe's Faust	"	Sen. and Jun.	33	5	"
FRENCH.					
Grammar and Exercises	**Huggins.**	**First.**	**65**	**7**	**I.**
Grammar and Reading	"	"	50	4	II.
Reading—Selections	"	"	50	3	III.
Fenelon's Télémaque	"	**Junior.**	**30**	**5**	**III.**
LATIN.					
Plautus	**Walker.**	**Senior.**	**56**	**4**	**I.**
Roman Literature, Lectures	"	"	14	4	I.
Juvenal	"	**Junior.**	40	6	III.
Tacitus, History	"	"	60	6	II.
Horace, Odes, &c.	"	**First.**	60	6	II.
Livy	"	**Second.**	120	21	II, III.
Virgil, Æneid	"	**Third.**	60	37	III.
Cicero, Orations	"	"	70	37	I.
Roman History	"	**Second.**	..	21	II. III.
Roman Antiquities	"	**Junior.**	..	6	III.
Latin Composition	"	**Third.**	..	37	III.
Virgil, Æneid	**Sutherland.**	**Third**	**60**	**37**	**II.**
Cicero, Orations	"	**Fourth.**	60	34	III.
Cæsar two sections	"	"	180	34	I & II.
Latin, Reader, two sections	"	"	180	39	I. II. III.
Latin Composition	"	Thd. & F'rth.	..	..	"
GREEK.					
Plato and Aristotle	**Brooks.**	**Senior.**	**55**	**3**	**II.**
Essays on same	"	"	3	3	II.
Greek Literature, Lectures	"	"	18	4	III.
Greek Literature, Reviews	"	"	13	4	III.
Plato	"	**Junior.**	**65**	**4**	**I.**
Essays on same	"	"	4	4	I.
Demosthenes, Olynthiacs	"	**First.**	**55**	**12**	**II.**

Subjects.	Instructor.	Class.	No. of Exercises	No. of Students	Term.
GREEK—(Continued.)					
Æschylus, Prometheus	Brooks.	First.	55	12	III.
History and Geography	"	"	10	12	II, III.
Homer, Iliad	"	Second.	63	13	I.
" "	Folwell.	"	53	13	II.
Greek History	Brooks.	"	15	13	I, II.
Essays	"	"	39	13	I, II.
Xenophon, Anabasis	"	Third.	121	8	I, II.
Greek Composition	"	"	80	8	I.
Grammar and Reader	" (J.C.H.)	"	176	18	I, II, III
PHILOLOGY (THEORETICAL)					
Lectures	Campbell.	Junior.	24	14	II.
MENT. AND MOR PHILOSOPHY.					
History of Philosophy	Campbell	Senior.	40	3	I.
Ontology	"	"	25	8	I.
Ethics	"	"	40	6	II.
Evidences of Christianity	"	"	15	6	II.
Psychology	"	Junior.	55	9	III.
Natural Theology	"	Senior.	12	4	III.
HISTORY OF CIVILIZATION.	Folwell.	Junior.	31	10	II.
POLITICAL ECONOMY.					
Lectures	Folwell.	Senior.	41	8	III.
SANITARY SCIENCE.					
Lectures	Hewitt.	Senior.	6	8	III.
Physiology	Peckham.	Fourth.	56	29	III.
INDUSTRIAL DRAWING.					
Free Hand Drawing	Peck.	Fourth.	55	40	III.
Plane Problems	"	Third.	55	49	II.
Projection and Isometric	"	Second.	55	25	II.
Descriptive Geometry	Rhame.	First.	55	3	II.
Descriptive and Perspective	"	"	55	5	III.
CIVIL ENGINEERING, &C.					
Applied Mechanics	Rhame.	Senior.	65	4	I.
Railroad Work	"	"	80	4	I.
Leveling	"	Junior.	25	3	I.
Topographical Drawing	"	"	65	3	I.
Stereotomy	"	Senior.	50	4	II.
Bridge Building	"	"	56	4	II.
Analytical Mechanics	"	Junior.	38	3	II
Shades and Shadows	"	"	55	3	II.
Geodesy	"	"	55	3	III.
Ventilation and Heating	"	"	80	1	III.
Building Materials	"	Senior.	25	3	III.
Applied Mechanics (steam)	Peck.	"	30	3	III.
MILITARY SCIENCE.					
School of the Soldier	Huggins.	Fourth.	15	70	I.
School of the Company	"	Four Coll.	15	150	I.
School of the Battalion	"	"	20	120	III.
Mil. History, Law and Eng.	"	Junior.	170	1	I. II. III

Extract from the Minneapolis Daily Tribune of July 25, 1875:

* * * * "Hon. John S. Pillsbury, President of the Board of Regents, expressed the pleasant emotions of that body in being able to welcome the audience to the University, to present an increased number of graduates, and in behalf of the Board to direct President Folwell to confer the degrees of the institution upon those now about to take their departure from its fostering care.

"Prior to the ceremony of conferring the degrees, in accordance with the direction of Mr. Pillsbury, Mr. Folwell spoke as follows:

"MR. PRESIDENT:—In proceeding to the duty with which you have officially charged me, permit me to notify your honorable Board that upon the graduation of these candidates we lose from our ranks the last remnants of that 'old guard' who rallied about the standard set up here at the first opening of scholastic work in this institution. We are parting, therefore, with some of the original founders of the University, for surely they must be reckoned such, who cast in their fortunes here, venturing their whole intellectual capital, at a time when the advantages of the University could only be seen by the eye of faith. At any rate, when our history shall be truly written, it will appear that these candidates and their predecessors were the pioneers who cleared the way and beat the path for all following classes and generations of students.

"Pioneers! The title suits them well. I trust our young friends will pardon me if I bring into too strong light passages of their career which they would modestly prefer to leave in shadow. I will only say that for a worthy purpose, I desire to have it known that the majority of these candidates have literally 'fought their way through college,' against poverty, against bodily infirmities, against the persuasions of friends who could not bear to witness the struggle. To reach this day, some of them have suffered from cold and hunger, and more than one has for a time succumbed beneath the double burden of scholastic duties, and the getting of daily bread. They have fought a good fight, they have kept that faith which bound them to an institution which as yet had no name among the colleges

of the land, and whose only glory was in the promise of her sons. '*Forsan olim meminisse juvabit.*' Yes. I trust they are satisfied now.

"Mr. President, my object in making this reference is that your honorable body and all concerned may know how worthily the public bounty, of which you are the honored custodians, has been bestowed, and also what kind of persons they are who are resorting to this State University for higher education. I wish that some persons who have publicly characterized the personnel of our student body had been better informed, as they easily might have been. Not many rich, not many mighty, are to be found among our numbers. Our wealthier citizens naturally patronize the older colleges of established reputation and national fame. Many old college alumni, with most pardonable and affectionate allegiance, send their sons to the old *Alma Mater*. There remain then to man the new State University the sons and daughters of the less wealthy, industrial classes. For one, I am much more than content that this should be so. It is for such as these that the States and the Nation have endowed and established the State Universities—in the language of a well-known statute, 'to promote the education of the industrial classes in the several pursuits and professions of life.' I may say further that since the wealthy form but a small proportion of our population, and their children have so many temptations to shirk the labor and sacrifices necessary to a course of higher studies, the students of this University, as of all others, at all times, will be permanently drawn from the working people. In the old Universities of Europe, before the custom of endowments came in, the students were privileged and distinguished beggars. Higher education has always and everywhere been either wholly or partially gratuitous.

"It becomes then a problem for your honorable Board, as at some time for all College Boards, how to order and dispose affairs as to bring the advantages of the University within the reach of those classes who at once best appreciate them, and are least able to afford the expenses.

"It may be said, at this point, that in providing these substantial buildings, in supplying them with costly furniture and apparatus, in collecting many thousand books, and especially in offering, free of charge, the instruction of a numerous corps of experienced professors and teachers, the State has done enough. The fountain has been set freely flowing, let those thirsting for knowledge come and drink.

"Mr. President, I would not trouble you at this time with this matter, if I did not deem it of first importance, not merely to yourselves and your corps of instruction, but to the whole University, to the University City and to the whole State.

"The University is passing out of her period of infancy. At the opening of the new year we occupy the new buildings, in which, our work heretofore cramped and crowded into small and inconvenient apartments, will look like college work.

"The Faculty, the buildings, the equipment will be adequate to the instruction of a large number of students, larger considerably, than we have, up to this time, been able to accommodate.

"The question is, will students come? If I may judge from several years experience in the institution and from hundreds of letters coming from all parts of the State, I can answer, they will, provided, the expenses of living in Minneapolis can be kept at low figures and that suitable accommodations be available. To offer free tuition to students who cannot afford to live at the University, is like setting a free table to poor people on condition that they come dressed in broad-cloth and riding in carriages. The plain conclusion is, that we must cheapen the costs of living, and increase the number of employments for students. Permit me merely to name a few of the means which in my opinion are now available:

"1.—The shortening of the University year by one or two weeks, and the condensation of it by contracting the recesses now given between the terms. In this northern latitude no large body of students can be supplied with paying employments during the winter, and if there could be, very few have the physical stamina to carry on a full course of study, and earn their daily bread at the same time. I know that this can be done, but I know that it is done at fearful risks. These candidates could give some testimony which would affect you as nothing I can say will do.

"We must then divide the year, giving the winter to study, the summer to work in imitation of the Universities of Scotland, which is also a northern country, with a rigorous climate, and a thrifty, intelligent, but not wealthy population. This arrangement will assemble the students at the close of the out-door working season, employ them during the colder months, and send them out at the opening of a following season—the young women to the summer schools, the young men to the shops and farms. I believe that in this way the higher education would be brought within the reach of a vast additional number.

"The vacation, thus lengthened by the new arrangement of the time, could be employed most profitably by the Faculty in authorship, in travel, and in carrying on literary and scientific researches. These are, next to the great work of instruction legitimate employments for college professors, and great is the fame of some of our American colleges, through the writings and investigations of their professors.

"2.—The next thing is the erection, or providing for the erecting of lodging houses, of a dining hall, and a suitable College Home for young ladies. It is not essential that any of these be built at the public expense. Indeed, there are strong reasons for preferring that private enterprise and beneficence be enlisted. But somehow these things must be got, if we mean to have the advantages of the University actually enjoyed by large numbers of students.

"During the past year some thirty of our most valuable students have been sheltered in the comfortable and tasteful lodging houses erected at the private cost of a benefactor* whose name and services need no mention. But for this opportunity many of these students could not have remained here. These rooms are now bespoken for another year. I believe that one hundred persons would gladly

* Governor Pillsbury.

avail themselves of similar opportunities, of whom but a small percentage will come here.

"I trust the example of this benefaction will be followed by other public-spirited citizens, and I wish that our Christian denominations could be induced to surround the University with a cordon of Christian college homes in which their sons and daughters might reside, amid holy and elevating influences and under suitable guardianship, resorting to the class rooms of the University for the free instruction offered there.

"This is no modern invention. The original college was merely a house or hostlery in which the students of a university were collected, lodged and fed. At a later period instruction was introduced and colleges, originally mere lodging places, are now everywhere teaching places.

"The proposition then is to return to the original college idea or institution. Here is the State University, fully equipped and constantly adding to her means of instruction. No other institution of higher education can be expected to compete with one supported by the wealth and influence of a great State, whose population are committed, heart and soul, to the cause of public education. But the churches cannot give up education: the State cannot divide the University. Let the churches then severally provide in the neighborhood of the University their college homes for both sexes, or for either sex, and gather their sons and daughters there, maintaining such discipline, ritual, and cultus as each body may prefer. In this way each church will have its college to all intents and purposes, and save the whole cost of college buildings, furniture, apparatus, library, museum and faculty. In this way we may at length form a union of church and State which no one could wish to sever.

"This plan will soon be carried out in some State, and great will be the renown and profit of that State. Shall that State be Minnesota?

"3.—Very much may be done by the University city to solve the problem of maintaining students. I desire here to return thanks to the citizens of Minneapolis and particularly to those who are our immediate neighbors, for many good offices in the way of hospitality and employment. The rapid extension of the University in this quarter gives assurance that soon there will be no lack of shelter for those who are able to pay, nor of employment to those who seek it with activity.

"4.—The students can do a great deal to keep education within the reach of the poor young men and young women: chiefly by refraining to import customs, sports, and institutions which grew up in colleges of quasi-monastic origin, and which are not appropriate to an institution open to all creeds and sexes. Let us preserve here the simplicity and sobriety becoming to us as beneficiaries of a republican state. Let us desire nothing in which all cannot share.

"To the candidates I have but little to say. We have wintered and summered together for many years, and if we have failed in our duty as instructors or as counsellors, it is too late to make up arrearages now. Most heartily do I return thanks, in behalf of the honorable Board of Regents, of the faculty and the undergraduate

members of the University, for the kind remembrances and wishes spoken by your chosen valedictorian. We wish you success. We believe you will have that success which is real, and that you know what success *is* real I have heard a mother in Israel say, 'Good daughters make good wives.' We know, from experiences of many years, that good students make good men. I am bound to declare that you have been, one and all, faithful and diligent. It was not written of any of you, 'Whoso putteth his hand to the plough and looketh back, is not fit for the Kingdom of God.'

"I know not by what happy chance it is that you have yourselves given us and each other from this rostrum the good advice and exhortation I should have wished to embrace in our last words to you. So you have left me nothing to say. You have one and another praised and illustrated the chief public and private traits and virtues. Free speech, the freeman's dearest right, and the duty of exercising that right in a free state; self-culture, the building of the man into the fullness of the stature of the one perfect and Godlike man; the nation's calls to public service, in peace as well as in war; knightly courtesy, the heritage of a thousand generations handing down to us the grand old name of gentleman; industrial education, as a source of national wealth and prosperity; public and private economy, on the good old 'pay as you go' principle: these are noble subjects, and they are mostly such as the educated men of our day ought to be thinking of. My exhortation, had it not been anticipated, would be to remember that your State and nation have a right to demand that you bring all your science and philosophy, and all your culture, to bear upon these and other serious public and private questions. You stand pledged to think and act on principles, and according to right reason. This, I suppose, is what your valedictorian means by her shrewd advice drawn from the motto* of the English painter. And this is the justification of the existence of this University and your long residence here."

At the conclusion of the President's address, the degrees were formally conferred. The benediction was pronounced by the venerable missionary, Dr. Thos. Williamson, and the formal exercises of the Commencement Day were brought to a close.

* "With brains, Sir."

APPENDIX C.

LIST OF DONATIONS

To the Library of the University of Minnesota, from July 1st, 1874, to July 1st, 1875.

Hon. Alexander Ramsey, United States Senator, St. Paul:
1 vol. Compendium of Ninth Census, 1870.
1 vol. Bureau of Statistics, Commerce and Navigation, 1872.

Mr. F. A. Husher, student:
2 vols. Norwegian text books.

Maj. Gen. A. A. Humphreys, U. S. A.:
2 pamphlets, Ornithological specimens, and catalogue of plants.

Hon. Elias Leavenworth, Syracuse, N. Y., (author.)
1 vol. Genealogy of the Leavenworth Family.

United States Government, through Departments:
5 copies Report of the Commissioner of Agriculture.
1 pamphlet, Report on the Irrigation of California.
1 pamphlet, Report on Building Stone.
3 copies first Report of the Commissioner of Agriculture, 1873.
1 vol. Statistical Atlas of the United States, parts I, II, III.
1 vol. United States Coast Survey, 1871.

Smithsonian Institution, Washington:
4 vols. Smithsonian Miscellaneous Collections.
2 vols. Smithsonian Reports for 1871-2.
1 vol. Smithsonian Contributions to knowledge.

Mr. James Hinton:
1 vol. Military Tactics, (British.)

Swedenborg Printing Society for America, New York.:
19 vols. Works of Emanuel Swedenborg.

Publishers' Agent:
1 vol. The Polar and Tropical Worlds.

Col. Geo. W. Ford, New York:
1 vol. Uniform Trade List for 1874.

Hon. Richard Chute, Minneapolis:
1 vol. Seward, W. H., Travels Round the World.

Professor R. W. Laing, LL. D.:
1 vol. Patent Office Report, Agriculture, 1849-50.
1 vol. Galtruchii Physica Universalis.
1 vol. Gardner's Farmer Dictionary.
1 vol. Journal of a Naturalist.
1 vol. Handbook of Chemical Analysis.
1 vol. Loomis, E., Recent Progress of Astronomy.

Hon. T. C. Abott, President Michigan Agricultural College:
2 vols. Reports Michigan Agricultural College, 1871-2.

Minnesota State Horticultural Society:
1 vol. Transactions Minnesota State Horticultural Society, 1872.
Pamphlets. Transactions Minnesota State Horticultural Society, 1873-4.

Minnesota State Agricultural Society:
1 vol. Iowa Agricultural Report, 1873.
1 vol. Geological Survey of Indiana, 1873.
1 vol. Transactions Minnesota State Horticultural Society, 1872.
2 vols. Ohio Agricultural Reports, 1872-3.

Hon. C. V. Ripley, Missouri State Entomologist:
6 vols. Agricultural Reports, Missouri, 1865-70.
3 copies Entomology of Missouri, VI Report.

Boston Public Library:
1 vol. Chronological Index to Historical Fiction.

Professor N. H. Winchell:
2 vols. Reports of the Department of Agriculture, 1870-71.

Government of Dominion of Canada:
1 vol. Geological Survey of Canada, Report, 1873-4.

Bussey Institution:
8 vols. Agricultural Reports.
1 vol. Bulletin, Bussey Institution, Parts I, II, III.

Ohio State Board of Agriculture:
1 vol. Ohio Agricultural Report, 1871.

Mrs. S. J. Hale, (author:)
1 vol. Biography of Distinguished Women.

Hon. William Lochren, Minneapolis:
1 vol. Statutes of Minnesota Revised, 1851.

Hon. Wm. Windom, United States Senator, Winona:
58 vols. Miscellaneous Public Documents.

Hon. Fletcher Williams, Secretary Minnesota Historical Society, St. Paul:
269 vols. Miscellaneous Public Documents.
21 vols. Annual Register, 1758 to 1781.
10 vols. St. Paul Daily Press, 1867, 1868, 1869, 1871, 1872.
7 vols. St. Paul Daily Pioneer, 1867, 1871, 1872, June to December, 1868.
1 vol. Minneapolis Daily Tribune, June to December, 1869.

APPENDIX D.

LIST OF BOOKS

Issued to students from the Library of the University of Minnesota, from September 22, 1874, to June 15, 1875.

Biography	134
History	219
Novels	176
Metaphysics	67
Belles Lettres—Prose	161
Poetry	167
Ancient Language and Literature	41
Modern Language and Literature	104
Natural History and Science	107
Mathematics	28
Travels	145
Political Science	55
Miscellaneous	165
Total number of books issued for home reading	1,569
Total number of books issued to reading room	720
Total number of books issued during the year	2,289

APPENDIX E.

List of Periodicals Supplied to the Reading Room.

QUARTERLY.

The Journal of Speculative Philosophy.
The New Englander.
The North American Review.
The Edinburgh Review.
The British Review.
The Westminster Review.
The London Review.

SIX TIMES A YEAR.

The International Review.

MONTHLY.

The American Journal of Science and Arts.
The Agriculturist.
The Journal of the Franklin Institute.
Appleton's Popular Science Monthly.
Scribner's New Monthly.
Harper's New Monthly.
The Sunday Magazine.
Blackwood's Magazine.
The Eclectic Magazine.
Van Nostrand's Engineering Magazine.

The Canada Farmer.
Illustrirte Zeitung (Leipzig.)
Harper's Weekly.
Army and Navy Journal.
Official Gazette U. S. Patent Office.*

SEMI-WEEKLY.

New York Evening Post.*

DAILY.

Minneapolis Tribune.*
St. Paul Pioneer-Press.*
War Department Weather Map, etc.*

*Furnished by courtesy of the publishers.

REPORT OF PROFESSOR RHAME

ON DEPARTMENT OF

ENGINEERING AND TOPOGRAPHICAL SURVEY.

UNIVERSITY OF MINNESOTA,
November 30, 1875.

To the President of the University:

SIR:—I have the honor to submit the following report of the work done in the department of civil and mechanical engineering, for the year ending June 24th, 1875.

The following table exhibits the classes taught and the subjects pursued during the year. [See appendix A.]

With the assistance of the students in this department, I have done some topographical work—laying out drives and walks on the campus, and other work. Several maps of the campus and adjoining grounds, and plans of the University building have been made for various purposes.

The facilities for instruction in this department have been considerably increased during the year. We now have 40 substantial drawing tables, and 12 Worcester adjustable tables, in all enough to accommodate each student with his own table. We have also procured a fine set of models, for illustrating the principles of descriptive geometry; also models of trusses for the use of students in bridge building. These models are all from the manufactory of Schroeder, of Darmstadt, Germany, and are now placed in a suitable case.

In regard to the topographical work in connection with the geological and natural history survey of the State, I have the following to report: We have made some progress in collecting information, material and maps, and in recording and arranging the same.

Maj. Gen. A. A. Humphreys, Chief of Engineers, U. S. A., has kindly furnished the University with the following tracings:

1. A map of the Mississippi River from the junction of the Minnesota River to the southern boundary of the State, in six sheets,

being a part of a map of the Mississippi River from the junction of the Minnesota River to the junction of the Ohio River, in 22 sheets, on a scale of two inches to the mile, compiled from surveys and examinations made by Brevet Maj. Gen. G. K. Warren, Major Corps of Engineers, U. S. A., and his assistants, in 1866, 1867, 1868 and 1869, and from the U. S. land survey, compiled principally by J. P. Colton, C. E., and C. H. Cornwell, C. E."

2. "Map of Survey of the Mississippi River at and above the Falls of St. Anthony, made in accordance with orders of Col. J. N. Macomb, U. S. Engineers, in charge of survey and improvements on the Upper Mississippi River, by Franklin Cook, Assistant Civil Engineer in local charge of works for the preservation of the Falls of St. Anthony." Dated "Minneapolis, Nov. 20, 1871."

3. "Extract from Military Map of the Department of Dakota, Eastern sheet."

4. "Portion of a map of the Valley of the Minnesota River from Lac Traverse to the Mississippi, made under direction of Brevet Maj. Gen. G. K. Warren, Major Engineers, U. S. A., by C. G. Davis, Civil Engineer. Scale two inches to the mile."

Very respectfully submitted,

M. D. RHAME,

Professor, &c.

REPORT OF THE STATE CHEMIST.

To the President of the University:

SIR:—Owing to the delays of contractors, the University was without a chemical laboratory during the whole of the year 1874–5. It was not until October 1st ultimo, that the new laboratory was so far finished as to permit analytical work by students, and much still remains to be done to put it in complete order. Of necessity, no analytical work proper could be carried on for the geological survey while there was no laboratory. I expect soon to be able to recommence analyses. I hope to render this department of the survey more fruitful in future than it has been under the adverse circumstances of the past two years. The resources of the laboratory are adequate to all operations likely to offer.

Respectfully, &c.,

S. F. PECKHAM,

State Chemist.

P. S. The great need of a cabinet of specimens to illustrate the course of lectures that I give each year in applied chemistry has led me to commence the collection of such a cabinet. The following donations have been made up to date:

Eleven large and fine specimens of coal, from the Kanawha Valley, W. Va., the gift of J. D. Budd, Esq., of Richmond, Va.

One specimen limonite, from same.

Two specimens foundry iron, from same.

Two specimens mill iron, from same.

A set of eight specimens of ores and slags, illustrating the operation of a blast furnace, from the Bellfont Nail Co.'s works, Ironton, Ohio.

A list of twelve specimens of raw and manufactured material, representing the manufacture of flint glass, from the Hemingray Glass Co., Covington, Ky.

Three very fine specimens of rolling-mill slags, from the Covington rolling-mill, Covington, Ky.

Specimens of French and English plate glass, from Messrs. Beck & Rank, St. Paul.

A set of more than twenty specimens, from the Star Glass Co., of New Albany, Ind., illustrating all of the materials and processes used there for the manufacture of American plate glass.

One very fine specimen of micaceous iron (Hematite) from J. A. Armstrong, Esq., of Minneapolis.

I hope to be able to make large additions during the ensuing year.

PROFESSOR HEWITT'S REPORT.

RED WING, November 30th, 1875.

To the President of the University:

SIR:—I have the honor respectfully to report that the text book instruction, in the Department of Public Health, during the year past has been given by Prof. Peckham, and that my examination of the class satisfied me that this necessary work was well done under his direction.

My own share of instruction has been confined to the preparation and delivery, to the senior class, of a course of six lectures on foods. This class had already had text book instruction, and attended my lectures on general hygiene a year before.

The discussion of the subject was prefaced with a review of the functions of food, and the processes of digestion, assimilation and excretion, in the human body. Specimens of the leading digestive agents, pepsin, pancreatin and diastase, were shown to the class, as also the process of artificial digestion by their use.

The chemistry of digestion was illustrated by the separation and analysis of the proximate elements, and by the discussion of their function in building up, warming, and changing the structure of the body. The great classes of natural foods, mineral, vegetable and animal, were separately studied by the aid of specimens of each, and their relations to each other, and the body, explained.

The use of art in the manufacture, preparation and preservation of foods was shown by the study of commercial and domestic methods. Then followed the very important subject of harmful change, sophistication and adulteration of foods, which was studied by the use of the simplest methods of detecting and preventing them, by experiments on suspected articles.

The discussion of the important class of accessory foods, tea, coffee, cocoa and its preparations. Alcohol, in its various forms for commercial and domestic use, was introduced by a statement of its chemical composition, and physiological action on the body, in health and disease. Then followed a statement of the most common adulterations of the accessory foods and the methods of detecting them. Their study was closed by a statement of the social and other evils growing out of their abuse.

My experience in the work assigned me here, has confirmed my convictions of its necessity, and of its value as a means of knowl-

edge and healthful culture. The time is not far distant when public health will receive its proper share of the time and study of all the students of the University.

It is proper to state that the interest and value of the lectures on food were very greatly increased by the use of specimens of pepsin, pancreatin, prepared food, etc., furnished for this purpose, by Dr. J. S. Hawley, 29 Tiffany Place, Brooklyn, N. Y., and by two collections of cocoa beans, and their artificial products, chocolates, bromas, etc., furnished by Messrs. Josiah Webb & Co., and Walter Baker & Co., of Boston, Mass.

All of which is respectfully submitted.

CHARLES N. HEWITT,
Secretary State Board of Health, and
Non-resident Professor of Public Health.

PROFESSOR LACY'S REPORT.

Wm. W. Folwell, President of the University of Minnesota:

SIR:—I respectfully beg leave to submit the following report of the present condition of the College of Agriculture and of what has been done in this department, the past year. It will be noticed that our efforts have been directed in the lines indicated in a former report.

INSTRUCTION.

During a portion of the winter term of 1874–5, instruction in arboriculture was given to the students of the elementary course in agriculture, two in number.

With the beginning of the present year two members of the junior class entered upon the studies of the regular course and have been receiving instruction in agricultural botany and landscape gardening, this to be followed in the winter term with a course in horticulture.

LIBRARY.

Fifty-two volumes of standard works treating of, or closely relating to, agriculture, horticulture, etc., have been added to the library, swelling the whole number to 104 volumes.

At the same time, through donations and exchanges of duplicate copies, the number of reports and transactions of agricultural and horticultural societies has been increased from 75 to 102 volumes.

The Farmers' Union, Prairie Farmer and American Agriculturist have been regularly received.

MUSEUM OF AGRICULTURE.

With the approval of the Executive Committee the nucleus of a museum has been collected. Its principal features are intended to be, (1,) hand implements and models of farm machinery; (2,) seeds of all kinds of cultivated and useful plants; (3,) grasses and grains in the straw; (4,) photographs, lithographs and drawings of domestic animals, machines, fruits, etc.; (5,) woods, wools, soils, and other objects of interest. A collection of seeds and of grasses and grains in the straw from each county in the State is desired.

Among the objects now on exhibition are the following: Of the

models relating to agriculture, received from the U. S. Patent Office, 105 were found in condition for exhibition, and have been labeled and arranged. Three hundred and seventeen exhibition bottles have been procured and one hundred and twenty-five specimens of seeds have been prepared. Fifty-eight specimens of grasses and grains in the straw have been collected. Colored lithographs of Devon herd and Merino flock, besides several fruit plates, have been procured and framed.

ORCHARD.

For purposes of illustration and experiment a small orchard has been planted. It contains 218 trees, many of them donated by the nurserymen of the State. The varieties are distributed as follows: Crab-apples and hybrids, 17 varieties; apples, 33 varieties; plums, 7 varieties; cherries, 4 varieties. These, with few exceptions, lived and have done well the past season.

It is worthy of note that trees, comprising several varieties of Russian apples, that have been growing on the farm for several years, on sandy soil, and in an exposed position, were not at all injured by the winter of 1874–5.

NURSERY.

One hundred and fifty-three trees, comprising seventeen varieties of apples and five varieties of crab-apples, donated or obtained by purchase, were too small to set at once in orchard and were consequently set in nursery row, unfortunately in sandy soil, and a large number died.

A large number of forest tree and other seeds, the accumulations of several years, were planted, but the only results were three or four varieties of pieplant. Several kinds of forest tree seeds, obtained by purchase, were also planted in the spring. These embraced chestnut, butternut, shag-bark hickory, black and honey locust, Kentucky coffee-tree, ailanthus, sugar maple, soft maple, ash-leaved maple, white, black, blue and green ash, Norway spruce and white pine. The following were the results:

The Norway spruce and white pine germinated but were not protected from the direct rays of the sun and so were destroyed. A few specimens were obtained of green ash, honey locust and Kentucky coffee-tree. The ailanthus, ash-leaved and soft maple germinated and grew well. The chestnuts were dug up by the gophers soon after planting. The others did not appear above ground until the weeds had attained such size and numbers that it was deemed best to plow the ground without regard to seeds

The obvious lesson of this planting is that it is better, when possible, to plant forest tree seeds in the fall, so that they may germinate before the weeds begin to grow in the spring.

The maples, elms and larches, heretofore standing in nursery, made a fair growth, the past season.

FRUIT GARDEN.

For purposes similar to those of the orchard, there have been planted, in the fruit garden, three varieties blackberries, nine varieties raspberries, eleven varieties currants, one variety gooseberries and eight varieties strawberries. About one-half only of the blackberries and raspberries survived the transplanting. The others lived and most of them made a fair growth.

VEGETABLE GARDEN.

In the vegetable garden there were planted, for experiment, besides other things, the following:

Beans	22 varieties.
Beets	5 varieties.
Cabbage	12 varieties.
Cauliflower	3 varieties.
Celery	5 varieties.
Cucumbers	5 varieties.
Lettuce	5 varieties.
Muskmelon	6 varieties.
Watermelon	6 varieties.
Onions	5 varieties.
Parsneps	2 varieties.
Peppers	3 varieties.
Peas	26 varieties.
Pumpkins	4 varieties.
Radish	5 varieties.
Squash	10 varieties.
Tomatoes	8 varieties.
Turnips	3 varieties.
Sweet and pop corn	12 varieties.
Broom corn	3 varieties.
Sweet potatoes	4 varieties.

In the following will be found a detailed statement of such experiments as yielded satisfactory results.

DWARF BEANS.

Planted May 20th, on poor sandy soil, plowed in 1874, and manured by applying composted stable manure broadcast and plowing in. Manured again in the row, when the beans were planted, with the same kind of manure.

The varieties planted were—

Early Six Weeks,	Early Valentine.
Early Rachel,	Early China.
Black Wax,	White Kidney,
White Wax,	White Marrow.

The Early Six Weeks were the earliest by at least three days, and of good quality. The Early Rachel were the most productive, and at the same time of good quality. While none were poor in quali-

ty, the Black and White Wax beans, coming about five days later than Early Six Weeks, surpassed all others in tenderness and delicacy of flavor.

POLE BEANS.

Planted May 21st, on soil ranging from sandy to sandy with some vegetable matter. Manured in the hill with compost of stable manure. Planted in hills three feet apart in the row, and the rows four feet apart. One pole, about five feet high, was set in each hill, and the vines pinched off when they reached the top. The following table is a statement of the most important results:

	Fit for shelling.	Yield.	Table quality.
Marblehead Champion	July 29.	Very good.	Very good.
Concord	Aug. 14.	Very good.	Very good.
Caseknife	Aug. 15.	Good.	Fair.
Cranberry	Aug. 20.	Good.	Good.
White pole	Aug. 20.	Fair.	Fair.
Giant Wax	Sept. 5.	Fair.	Very good.
Sieva	Sept. 8.	Very good.	Very good.
Australian Wonder	Sept. 8.	Fair.	Poor.
Scarlet Runner	Sept. 12.	Poor.	Poor.
Large Lima	Sept. 15.	Poor.	Best.

Carter's Champion, Negro Champion, Canada Wonder and Yard Long varieties were also planted, but in quantities too small to admit of comparison.. The Giant Wax is also a fine snap bean, but its season for this purpose was not noted. The Sieva is much like the Lima Bean, but smaller in vine, pod and seed.

BROCCOLI.

Planted on light, sandy soil, and also upon loamy, richer soil, and at different times, but no perfect heads were obtained.

BRUSSEL'S SPROUTS.

Probably owing to the time of setting, or the soil, which was sandy, or to both, no results were obtained with this vegetable.

EARLY CABBAGES.

Planted seed in hotbed, April 2d. Transplanted, May 7th, into soil ranging from poor sand to sand with some vegetable matter. The weather being cold and unfavorable at that time many plants failed and the remainder grew but little for a long time. The following are the chief observations taken:

Little Pixie.—Large enough for use July 7th; head, when full

grown, only small, but very solid and of good quality; only a fair proportion of the plants formed heads.

Early York.—Large enough for use July 11th; head, when full grown, larger than Little Pixie but not so solid; quality, fair; only a fair proportion of the plants formed heads.

Early Wakefield.—Large enough for use July 17th; head, when full grown, solid and of good size; quality, good; headed well.

Early Winnigstadt.—Large enough for use July 20th; head, when full grown, very solid and of good size; quality, good; best heading early cabbage; may also be planted for late.

Early Ulm Savoy.—Some heads were found in September, but these were small and not solid; did not head well; richer soil would doubtless have improved this feature. The Savoy cabbages are distinguished by the crisped or rumpled appearance and are considered by most lovers of cabbage to be much finer than the common varieties.

LATE CABBAGES.

Seed sown in bed, in open ground, May 24th. Transplanted June 10th into a loamy sand in poor condition, manured previously with manure from the slaughter house, spread upon the surface and plowed in. The plants were set in rows four feet apart, and three feet apart in the row. Cultivated and hoed sufficiently to keep the weeds out.

In earliness they ranked in the following order:

First, Fottler's Improved Brunswick.
Second, Flat Dutch
Third, Large Late Drumhead.
Fourth, Stonemason.
Fifth, Premium Flat Dutch.
Sixth, Imperial.
Seventh, Marblehead Mammoth Drumhead, and Fine Red Dutch.
Eighth, American Savoy.

In the proportion of plants that formed good heads, they stood in the following order:

First, Flat Dutch.
Second, Premium Flat Dutch.
Third, Stonemason.
Fourth, Fottler's Improved Brunswick.
Fifth, Large Late Drumhead.
Sixth, Fine Red Dutch.
Seventh, Imperial.
Eighth, Marblehead Mammoth Drumhead.
Ninth, American Savoy.

In eating quality, they ranked as follows:

First, American Savoy.
Second, Imperial, and Fottler's Improved Brunswick.

Third, Large Late Drumhead, and
Premium Flat Dutch.
Fourth, Stonemason,
Flat Dutch,
Marblehead Mammoth Drumhead, and
Fine Red Dutch

CAULIFLOWER.

Seed sowed in hotbed, April 3d, and transplanted into a vegetable loam, May 10th. With the later care and cultivation precisely the same as for cabbages, good heads were obtained from the Early Paris, Carter's Dwarf Mammoth and Le Normand's varieties. More moisture than for cabbages is, however, required. Under the same circumstances, the Early Erfurt failed to form heads.

CELERY.

Five varieties were grown, as follows:

White Solid, Dwarf Crimson.
Boston Market, Laing's Mammoth Red.
Sandringham Dwarf White.

But their merits were not sufficiently observed to warrant a statement of them here.

SWEET AND POP CORN.

Early Minnesota.—Planted May 15th, on soil running from very sandy to sandy with some vegetable matter; manured in the hill with compost of horse manure; cultivation, ordinary; fit for use, Aug. 14th, earliest of all; stalks small, fairly productive; ears very small; quality very good; earliness and good quality are its good points.

Early Selected Sweet.—Planted May 15th, on poor sandy soil, with a slightly northern slope; manured as above; cultivation, ordinary; fit for use, Aug. 19, five days later than Early Minnesota; stalks small but more productive, and the ears larger than Early Minnesota; quality very good.

Crosby's Early.—Planted May 21st, on poor sandy soil and manured as above; cultivation, ordinary; fit for use Aug. 22d, eight days later than Early Minnesota; stalks small, fairly productive, but more so than Early Minnesota; ears medium size; quality very good.

Moore's Early Concord.—Planted May 21; soil, sandy with some vegetable matter; manured in the hill with composted stable manure. Proved about the same, in all characterestics and qualities, as Crosby's Early.

Marblehead Mammoth Sweet.—Planted on loamy sand, in fair condition, May 22d; manured in the hill with compost of stable manure; cultivation, ordinary; frost prevented it from coming into

Stowell's Evergreen.—Planted on loamy sand, in fair condition, May 22d, manured in the hill with compost of stable manure; cultivation, ordinary; fit for use September 10th; maintained its reputation, already well known for good quality, fair productiveness and fair-sized ears.

Scotts' No. 1—(*crossed.*)—Planted May 22d, on loamy sand, in rather poor condition; manured in the hill with compost of stable manure; cultivation, ordinary; fit for use Sept. 4th; stalks, large, very productive; ears large; quality good; an evergreen variety produced by crossing White Dent on the old sweet corn and selecting from the cross.

Scott's No. 2—(*selected.*)—Planted May 20th on same kind of soil as Early Minnesota; manured in the hill with compost of stable manure; cultivation, ordinary; fit for use Sept. 7th; stalks very productive; ears very large; quality very good; an evergreen variety formed by the selection of ear and grain for six years, beginning with the old common sweet corn.

Pop Corn.—Several varieties were planted. Seed was obtained from the Rice-shaped Pop, Minnesota Red and New York Blue. Rice-shaped Pop proved the best both in quality and yield.

CUCUMBERS.

Exact observations, further than the following, were not made:

In order of earliness they stood—

First, Early Cluster.
Second, Early Frame.
Third, White Spine.
Fourth, Long Green.

In order of productiveness they stood—

First, White Spine.
Second, Long Green.
Third, Early Frame.
Fourth, Early Cluster.

LETTUCE.

The varieties sown were Large India, Hanson, Early Butterhead, and Early Curled Silesia. These were sown in hotbed, April 5th, and transplanted to the open ground May 7th. The following are the principal results obtained:

Large India.—Largest heads and best quality.

Hanson.—Almost equal to Large India in size and quality, and a couple of days earlier.

Early Butterhead.—Heads smaller and quality not so fine, but came to head earlier than the above.

Early Curled Silesia.—Not quite so early as the Early Butterhead.

Were sown April 12th to 14th, on new soil, plowed in 1871, and again just before sowing. The soil was a loamy sand, containing considerable vegetable matter. The lumps and sods were raked off with a hand rake, a line stretched, and the seed sown by this line with a Harrington Seed Drill. The seed came up well, and the onions grew well through the season But a late weeding made necessary by the growth of weeds, deferred the ripening. They were harvested October 5th, when it was found that Large Red had matured best, Yellow Danvers second, and White Portugal third, while for table quality they ranked in the inverse order—White Portugal first, Yellow Danvers second, and Large Red third. The other varieties failed to mature at all.

PEAS.

The varieties found in the following tables were sown at three different times, corresponding to the three classes—early, second early and late, as found in most seedmen's catalogues. The circumstances of soil, method of planting, fertilizer, were the same in all cases. Soil, light, sandy and poor, plowed in 1874 and harrowed over before planting. A furrow was made about four inches deep, the peas planted in the bottom with a Harrington seed drill, some animal fertilizer then applied by hand in the drill and the whole covered with a plow. The cultivation was ordinary in every respect, simply sufficient to destroy the weeds. The yield, eating quality, picking season and growth of vine differed widely as indicated in the tables. The terms, "best," "very good," "good," "fair," and "poor" are used to expess the yield, and the same to expess the quality, "first" being substituted for "best," while the picking season is indicated as, "long," "medium" or "short," and the growth as, "very large," "large," "medium," "small" or "dwarf:"

EARLY PEAS—PLANTED APRIL 14TH.

	First picking.	Yield.	Table quality.	Picking season.	Growth of vine.
Early Caractacus...	June 9.	Good.	Very good.	Short.	Small.
M'Lean's Blue Peter	June 12.	Best.	First.	Medium.	Dwarf.
Nutting's No. 1....	June 12.	Good.	Very good.	Short.	Small.
Kentish Invicta....	June 14.	Best.	First.	Long.	Small.
Laxton's Alpha....	June 16.	Poor.	First.	Short.	Small.
M'Lean's Little Gem	June 18	Fair.	Good.	Short.	Dwarf.
Early Kent.....	June 18.	Good.	Fair.	Long.	Medium.
Carters' Firt Crop..	June 20.	Fair.	Fair.	Short.	Medium.

Attention is invited to the Early Caractacus as the earliest pea and of very good quality, while Kentish Invicta and McLean's Blue Peter stand above all the rest in the number and excellence of their good qualities.

SECOND EARLY PEAS—PLANTED APRIL 19TH.

	First picking.	Yield.	Table quality.	Picking season.	Growth of vine.
Eugenie	July 8.	Best	Very good	Medium	Medium
Laxton's prolific early long pod	July 10.	Fair	Good	Short	Large
McLean's Princess Royal	July 10	Good	Good	Medium	Medium
Dwarf Blue Imperial	July 10.	Best	Very good	Medium	Medium
Napoleon	July 12.	Good	Good	Medium	Medium
McLean's Advancer		Good	Very good	Medium	

Of these, would recommend Eugenie and Dwarf Blue Imperial for their many good qualities.

LATE PEAS—PLANTED APRIL 26TH.

	First picking.	Yield.	Table quality.	Picking season.	Growth of vine.
Tall Sugar	July 10.	Poor	Good	Short	Large
Champion of England	July 12.	Fair	Good	Long	Large
Yorkshire Hero	July 12.	Good	Good	Long	Medium
Veitch's Perfection	July 14.	Best	Very good	Long	Medium
McLean's Premier	July 10.	Good	First	Long	Medium
Carter's Surprise	July 16.	Best	Very good	Medium	Medium
Dwarf Waterloo Marrow	July 14.	Good	Very good	Medium	Medium

Omega, Laxton's Superlative, Dwarf Branching, Mummy and Dwarf Sugar were also planted but not under circumstances that permitted of comparison.

SQUASHES.

Of summer varieties, Early Scollop Bush, Variegated Scollop Bush and White Crookneck Bush were planted, but no observations of interest or value were made.

Of winter varieties Marblehead, Butman, Turban, Hubbard and Mammoth Chili were planted, but the conditions of the trial, and consequently the results, were unsatisfactory.

TOMATOES.

Canada Victor.—Began to ripen August 1st; earliest; fruit small, smooth, liable to crack; ripens unevenly, and when ripe does not keep as well as some others; quality very good; vine very small; fairly productive.

Hathaway's Excelsior.—Began to ripen August 3d; fruit medium size, very smooth, solid and heavy; quality very good; vine medium size, very productive; no bad points.

General Grant.—Began to ripen August 5th; fruit flatter in form, not so smooth, but otherwise equal to Hathaway's Excelsior; fruit keeps longer after ripening than that of any other variety.

Large Smooth Red.—Began to ripen August 7th; fruit rather small, very smooth, solid; quality good; vine medium, not very productive compared with others; not very desirable.

Trophy.—Began to ripen very late, latest of all by seven to ten days; fruit very large, tolerably smooth; quality fair; vine very large, fair producer; objectionable, especially in wet weather, on account of fruit rotting.

Pear Shaped Yellow.—Fruit largest of small kinds; has no equal in flavor among tomatoes for canning and preserving; vine quite productive.

Red Cherry and *Yellow Plum.*—Fruit useful for pickling, but more interesting as curiosities than for any other purpose.

SEEDS.

In procuring the seeds planted in the above experiments, efforts were made, first, to obtain seeds grown in Minnesota. These were ordered of R. W. Woodville & Co., Northfield. Secondly, effort was made to obtain seeds grown in or near our own latitude. These were ordered of J. J. H. Gregory, Marblehead, Mass. A few not found in these catalogues were ordered of James Vick, Rochester, N. Y. No fault could be found with the quality of seeds obtained from any source.

SWEET POTATOES.

Owing to delay in the receipt of the seed, it was not set in hotbed until April 21st. The plants were set in the open ground May 29th. The soil was dry and sandy, and the preparation consisted in throwing it into ridges eight or ten inches high, by throwing two furrows together back to back, with a common plow. On the summit of these ridges the plants were set when taken from the hotbed. The cultivation given consisted simply in skimming over the surface sufficiently often to destroy the weeds, almost before they appeared above ground. The varieties planted were the Red Bermuda, Brazil, Jersey White and Southern Queen. The Southern Queen matured before the frost of September 16th, and it is believed that the others would have matured also, had they been set out ten days earlier. The Southern Queen were also the best in quality, and gave the best yield, agreeing in the former respect with the results of last year. The Red Bermuda were the largest, but at the same time the coarsest in flesh. The attempt to grow sweet potatoes, except on dry, warm, sandy soil, will not be worth the trouble.

FARM EXPERIMENTS.

These include experiments with different kinds of fertilizers, and with the different kinds of farm crops.

In giving the results of the following experiments, we fully realize that an opportunity is given for sharp criticism. We are not sure but that the disposition to bestow this criticism will cause to be entirely overlooked those results which posses either value or interest. It must be noted, however, that the object of these experiments was not to produce large crops. On the contrary, land in poor condition was purposely chosen, because it would serve the purpose better. The object was to show which varieties are the most productive, and which fertilizers would give the best yield. It is presumed that those varieties and fertilizers which gave the best results in these experiments, are the best adapted for poor soils. It is further presumed, until proved otherwise, that the same varieties and fertilizers will give corresponding good results on good soils. Looked at from this point of view, our object seems to have met with a fair degree of success, and hence the experiments are given.

In justice to the Agricultural College Farm, it should be said that the land employed in the first five experiments does not belong to the farm, but was chosen because of its low condition, its uniform character, and its convenience. In justice to ourselves, also, it should be said that the soil chosen proved poorer than we supposed it possible for soil to be.

SET I. VARIETIES OF WHEAT.

Soil dry and sandy, a part sandy with considerable vegetable matter. Plowed about five inches deep, April 12th to 18th, and harrowed before sowing. Seed sown April 20th, with a Horicon seeder. Peruvian guano was then sown broadcast by hand, at the rate of 300 pounds per acre, and covered with a double stroke of the harrow. Difference in time of ripening slight, and not noted. Harvested August 3d.

The following table exhibits the results:

	Seed sown, in pounds.	Product in pounds.		Seed per acre in pounds.	Product per acre in pounds.	
		Grain.	Straw.		Grain.	Straw.
Arnotka	9½	19⅜	161½	95	195	1,615
Oran	10	30½	165	100	305	1,650
Fife	9¾	35½	167	97½	355	1,670
China Spring	10¼	35⅜	142⅜	102½	355	1,425
Mediterranean Spring	10¾	44½	140⅜	107½	445	1,405
Mixture of above five	10½	50¼	147¾	105	502½	1,477

SET II. VARIETIES OF WHEAT.

The soil, its preparation, manner of sowing seed and applying fertilizer, same as in Set I. Seed sown April 21st. Peruvian guano

	Seed sown lbs.	Product in lbs.		Seed per acre in lbs.	Product per acre in lbs.	
		Grain.	Straw.		Grain.	Straw.
Fife wheat	10	43½	141	100	435	1,410
Mixture wheat, barley and oats	11	49	110	110	490	1,100

SET III. DIFFERENT QUANTITIES OF SEED.

The soil, its preparation, and manner of sowing seed, and applying fertilizer the same as in Set I. Seed sown April 21st. Peruvian guano applied at rate of 200 pounds per acre.

The following table shows the results:

	Seed sown, pounds	Product in pounds.		Seed per acre, in pounds	Product per acre in pounds	
		Grain.	Straw.		Grain.	Straw.
Fife Wheat	10	43½	141	100	435	1,410
Fife Wheat	7½	43	130	75	430	1,300

SET IV. FERTILIZER ON WHEAT.

The soil, its preparation and manner of sowing seed and applying fertilizer, the same as in Set I. Seed sown April 21st at the rate of 100 lbs. per acre. The following table exhibits the results:

	Fertilizer applied lbs.	Product in lbs. Grain.	Straw.	Fertilizer per acre lbs.	Product per acre in lbs. Grain.	Straw.
No manure	00	19¾	76¼	000	197½	762½
Bone flour	31	24¼	71¼	310	242½	712½
Superphosphate of lime	30	27¼	76¼	300	272½	762½
Animal fertilizer	41.7	27½	76	417	275	760
Peruvian Guano	20.0	43½	141	200	435	1,410

The cost of the fertilizer was the same in each case, $7.50 per acre.

SET V. VARIETIES OF OATS.

The soil, its preparation, and the manner of sowing seed and applying fertilizer same as in Set. I. Seed sown April 22d. Animal fertilizer applied at the rate of 300 pounds per acre. The following table exhibits conditions and results:

	Seed sown lbs.	Product in pounds. Grain.	Straw.	Seed per acre, in pounds	Product per acre in pounds. Grain.	Straw.	Harvested.
Canadian	10½	56	78½	105	560	785	Aug. 2.
White Schonen	9½	57½	85¼	92½	572½	852½	Aug. 2.
Silver White Queen of the Earliest	10½	45	51	102½	450	510	July30.
Excelsior	10½	42½	62½	105	425	625	Aug. 1.
Probstelr	6¾	66¼	84½	67½	662½	842½	Aug. 3.
Black Norway	7¼	59½	82	72½	595	820	Aug. 3.

It will be noticed that the Silver White were the earliest. Owing to this fact, they were more injured by the gophers than any other, which partly accounts for the small yield given in the table. The Excelsior were observed to shell badly in harvesting.

VARIETIES OF FIELD CORN.

Numerous varieties were planted, but to prevent mixing, they were planted in different places and consequently the conditions of growth were widely different, and the results do not admit of close comparison. The following observations only could be made:

State Farm Yellow Dent.—Planted May 17th on sandy soil; manured in the hill with compost of stable manure; cultivation, ordinary; ripe Sept. 13th; stalks medium size; ears medium size; yield fair.

Mammoth Yellow Dent.—Planted May 18th on sandy soil in moderate condition. Manured broadcast on the surface with stable manure and harrowed over. Cultivation ordinary; ripe Sept. 15th; stalks large; ears large; yield fair.

State Farm White Dent.—Planted May 19th on sandy soil in good condition. Manured in the hill with wood ashes. Cultivation ordinary. Ripe Sept. 16th; stalks large; ears large; yield fair.

Adam's Early White Dent.—Planted May 14th on soil ranging from sandy to sand with some vegetable matter, in poor condition. Manured in the hill with animal fertilizer mixed with bone flour. Cultivation ordinary; ripe about Sept. 1st; stalks small; ears medium size; yield fair. Smallest Dent corn.

Improved Northern White Dent.—Planted May 14th on same kind and condition of soil as Adam's Early. Manured in the hill with bone flour mixed with animal fertilizer. Cultivation begun by harrowing before the corn came up and finished with the double shovel plow, otherwise ordinary. Killed by the frost of Sept. 16th, before maturing.

Illinois Large Yellow Dent.—Planted May 14th on sandy soil in poor condition. Manured in the hill with compost of stable manure. Cultivation ordinary. Killed by the frost of Sept. 16th, before it came into good roasting condition.

Hawkins' Improved White Flint.—Planted May 22d on sandy soil in fair condition. Manured in the hill with Peruvian Guano. Cultivation ordinary. Killed by the frost of Sept. 16th, before ripe.

Large Yellow Flint.—Treated in all respects like the above. Killed by the frost of Sept. 16th, before ripe.

Several other varieties,—Canada Yellow Flint, Large White Flint, Tuscarora Flour, a short-eared Brown Flint, a long-eared Brown Flint and Early Sanford,—were planted, but under conditions that admitted of no fair test. A dwarf variety of Yellow Flint, known as Tom Thumb, was planted on sandy soil, May 22d, and was ripe Aug. 25th.

It is worthy of note that all those varieties that matured by or before frost were grown from seed grown in Minnesota, while the seed of all those that failed was obtained outside of the State.

The following experiment with fertilizers on corn was projected, but the details were so defectively arranged that no satisfactory results can be claimed. Simply the data, with some observations, are therefore given, from which each one may draw his own conclusions.

The soil was sandy and light. A sod was turned under the previous year, and left until spring, when it was thoroughly harrowed and marked one way with a corn-marker and the other with a plow. The fertilizer was applied in the hill, in the bottom of the furrow, at the intersection of the marks, the corn dropped directly upon it, and covered with a hoe. The first cultivation was given with the harrow, just before the corn came up. After this it received simply ordinary cultivation, without any hand hoeing, the weeds simply pulled before they ripened. It was planted May 19th, and harvested October 15th.

	No. of hills planted.	No. of stalks that grew.	Quantity of fertilizer. lbs.	Yield by bushels.	Quantity of fertilizer per acre, lbs.	Yield bushels per acre.	Cost of fertilizer.
Peruvian Guano.....	576	1,460	14.5	18.0	78	97	$2.93
Superphosphate.....	576	1,717	22.0	17.5	118	94	2.89
Bone flour.....	576	1,565	22.0	17.5	118	94	2.89
Animal fertilizer.....	576	1,531	41.0	17.3	220	93	3.85
Hard-wood ashes....	576	899	65.0	9¼	350	49	
No manure.....	576	1,736		14		75	
Gypsum.....	480	1,230	103.0	15½	664	100	
Stable manure.....	432	1,128	1 2-horse load.	14¼	7 loads.	104	7.00

The difference between the manured and unmanured plats is readily observed but the differences between the different kinds of fertilizers are not so remarkable and may be due wholly or in part to the defective details above mentioned. In no case did the seed germinate perfectly, but in the plat manured with ashes the germination was especially defective, the seed doubtless being injured by them, and to this fact the small yield is to be attributed. Differences in the appearance of the plats were plainly exhibited throughout the greater part of their growth. Throughout the early part of growth the plats treated with guano and stable manure lead all the others in thrift and luxuriance, the animal fertilizer, superphosphate and bone flour following in order named. The plats with ashes, gypsum, and with no manure were the poorest and about equal. Later, the plat treated with ashes assumed a deep healthy green and attained a good size. In ripening that without manure was somewhat earlier than any of the others, while those with ashes, bone flour and superphosphate were later than the others by about ten days.

VARIETIES OF POTATOES.

Planted May 1st, on a thin, sandy loam, with white sand subsoil. Soil in poor condition, plowed in 1874. Manured in the row with slaughter house manure, at the rate of 12 two-horse loads per acre. The potatoes were cut to a single eye. Furrows were made with a plow, three feet apart, the pieces dropped in the bottom, the manure put over them, and the whole covered with a plow. The ground was thoroughly harrowed before the potatoes came up, and they were ridged before the vines fell down. Otherwise the cultivation was ordinary. The table quality stated is only to December 1st. The terms used to designate quality are "best," "very good," "good," "fair," "poor," "very poor;" and to designate size, "very large," "large," "medium," "small," "very small." It will be noted that the last columns show the *rate* of seed and yield per acre, and not the actual measurement of an acre.

	Quantity of seed.	Length of row—feet.	Yield, bush.	Table quality.	Size of tubers.	Large enough for use.
Alpha	1 lb.	60	1–2	Very good.	Medium.	July 7.
Early Ohio	1 lb.	60	9–10	Very good.	Medium.	July 7.
Extra Early Vermont	1 peck.	464	3 1–2	Good.	Very small.	July 7.
Early Favorite	1 peck.	684	4 1–4	Good.	Very small.	July 7.
Snowflake	½ peck.	240	1 9–10	Very good.	Medium.	July 10.
Early Rose	1 peck.	416	3 9–10	Very good.	Medium.	July 10.
Early Nonsuch	1 peck.	864	9 1–2	Good.	Medium.	July 15.
Peerless	1 peck.	364	4	Good.	Large.	July 20.
Brownell's Beauty	1 peck.	628	7	Best.	Very large.	July 22.
Compton's Surprise	1 peck.	628	7	Best.	Medium.	July 22.
Late Rose	1 peck.	522	6 1–2	Best.	Medium.	July 30.
Excelsior	1 peck.	464	5 1–4	Fair.	Large.	Very late.
White Blow French	1 peck.	220	3 3–4	Good.	Large.	Very late.
Eureka	½ peck.	332	4	Poor.	Large.	Very late.
Acme	1 lb.	40	1–2	Poor.	Medium.	Very late.

Alpha.—Tuber roundish: skin very smooth, white: flesh nearly white; medium fine.

Early Ohio.—Tuber round-oblong; skin very smooth, rose or pink: flesh fine, clear white. Good even before maturity.

Extra Early Vermont.—Tuber oblong-oval; skin rough, rose or pink; eyes small and shallow.

Early Favorite.—Skin white, smooth; flesh white.

Snowflake.—Tuber oblong-oval, compressed: skin white; flesh white, fine.

Early Nonsuch.—Tuber somewhat cylindrical, flattened: skin pale russet, somewhat rough: flesh white: eyes few, shallow.

Peerless.—Tuber flat-round; skin dull white, russetted; flesh white, medium fine; has been grown here several years, and sustains a good reputation.

Brownell's Beauty.—Tuber oval or oblong oval: skin deep flesh color: flesh white: eyes few and shallow.

Compton's Surprise.—Tuber oval-oblong: skin reddish purple, somewhat rough: flesh white.

Late Rose.—Similar in form and color to Early Rose: flesh white, fine.

Excelsior.—Tuber nearly round, flattish; skin white, smooth; flesh white, medium fine: eyes deep.

White Blow French.—Tuber round-flattened; skin white, dashed with pink, rough: flesh coarse: eyes deep. Inclined to rot.

Eureka.—Tuber elongated-oval, somewhat flattened: skin white: flesh white; eyes deep.

Acme.—Tuber long-oval: skin white, rather rough; flesh white, medium fine: eyes shallow.

distance of 10 or 12 inches in the row, after they reached the size of pipe stems Treatment otherwise only ordinary. Harvested about October 15th.

While the yield was in no case one-half what it should be with good soil and cultivation, the object of the experiment, to determine which varieties were most productive, was fully attained. This is shown in the following table.

	Length of row, feet.	Yield in bushels.	Yield per acre in bushels.	Remarks.
Yellow Globe Mangold..	600	11¼	278 3	Smooth, free from fibrous roots; flesh fine grained.
Yellow Ovoid Mangold..	600	13⅛	326.7	Has the same good points as the above.
Long Red Mangold.....	600	9	217.8	Numerous fibrous roots; hollow-crowned, and liable to split; flesh coarse grained.
Red Giant Ovoid Mangold	600	14	338.8	Flesh medium fine; the other points all good.
Carter's Orange Globe Mangold.....	600	14	338.8	Flesh fine grained, and has no serious objections.
Imperial White Sugar Beet.....	600	12½	302.5	White, cleans nicely; form somewhat globular; flesh fine grained.
Carter's Mammoth Long Red Mangold.....	600	12	290.4	Hollow-crowned, and flesh coarse; numerous fibrous roots.

FERTILIZERS ON POTATOES.

Potatoes planted May 21st, on sandy soil containing considerable vegetable matter. Fertilizer applied in the row and covered with the seed. Cultivation ordinary; the rows ridged up before the vines fell down. Variety, Early Rose. Harvested Oct. 7th:

	Length of row planted, feet.	Quantity of fertilizer used.	Yield in bush.	Fertilizer per acre.	Yield per acre in bushels.
Compost of stable manure	332	¼ load.	4¼	10.9 loads.	185.8
Peruvian guano.....	332	12 lbs.	3½	525 lbs.	153.0
Superphosphate of lime..	332	18 "	3½	787 "	153.9
Bone flour	332	18 "	3½	787 "	153.0
Animal fertilizer..... ...	332	25 "	4	1,093 "	175.0
No manure.....	332		3½		153.0
Gypsum.....	332	18 lbs.	4¼	787 lbs.	185.8
Ashes.....	332	1 bush.	4	43.7 bush.	175.0

The surprising feature in the experiment is the low yield obtained from 525 pounds per acre of Peruvian guano. Should further experiments give like results it would prove the entire worthlessness of this costly fertilizer for potatoes. But it should be noted here that no final conclusion can be drawn from a single experiment of this kind. The results of the next one may entirely contradict these. Final conclusions must be based not upon one experiment but upon several. The results obtained from stable manure, gypsum, and no manure, agree substantially with the results obtained from these fertilizers in 1874.

DESCRIPTION OF FERTILIZERS.

The following is a brief description of the fertilizers mentioned in this report.

The Peruvian guano was obtained from R. H. Allen & Co., of New York city, and was genuine, judging both from its appearance and its effects. Its cost was $75.00 per ton. The animal fertilizer was obtained from James H. Morris, Chicago, and was made by quickly drying slaughter house refuse, flesh, skins of entrails, blood, &c., at a high heat, and then reducing to a powder. The cost was $35.00 per ton. The bone flour and superphosphates of lime were obtained from Lister Bros., Newark, N. J. The former was simply finely ground bone, and cost $47 00 per ton. The latter consisted of burned bones, or bone black from the sugar refineries, treated with sulphuric acid, and reduced to powder. By this treatment the phosphate becomes more soluble. Its cost was $49.00 per ton.

VARIETIES OF FIELD BEANS.

Soil sandy, with considerable vegetable matter, in fair condition. No fertilizer used. Planted May 27th. The varieties planted were Red Kidney, White Kidney, White Marrow, White Medium, and White Pea. They came up unevenly, but afterwards grew and matured well. Owing to the manner of coming up and bad weather at time of harvest, no exact results were obtained.

GRASSES.

Thirty-nine plats, each one rod square, were sown with grasses, and clovers, and different mixtures of grasses. This being the first year of their growth, no observations worthy of note were made.

FARM CROPS.

Land not otherwise employed was devoted to ordinary farm crops, from which were obtained 175 bushels oats, 90 bushels of potatoes, and 125 bushels of corn.

The quantity of hay cut and put up is estimated at 60 tons.

Among the improvements may be mentioned, setting a row of elm trees on either side of the University avenue, where it runs through the farm, and hauling large quantities of manure.

PREPARATIONS FOR FUTURE.

Preparations for continuing and expanding the work of the past season have been made by plowing, manuring, &c.

FARM.

The recommendation to dispose of the present farm and procure a more suitable one, or to effect an exchange, was referred, at a former meeting of the Board of Regents, to the Executive Committee. It may not, however, be improper to state briefly, in this connection, the reasons for such recommendation. They are:

1st.—The present farm, consisting of about 120 acres, contains less than half the area that will be required for the full development of the Department in accordance with contemplated plans, and the cost of adjoining lands is too great to allow of making additions.

2d.—It is not in proper condition to serve the purposes now required of it or contemplated in the future. A portion of it is very sandy and in poor condition, the remaining part is saturated with water during a considerable portion of the year. These faults could be corrected in course of time were the size of the farm satisfactory, but the cost would be about $50 per acre, and then the soil would not fairly represent the soils of the State.

This move does not involve any pecuniary outlay. The proceeds of the present farm would purchase the required number of acres within suitable distance.

Early action in this matter is desirable, in order that this Department may work more effectively, and improvements be made where they will be of lasting value.

PLANT HOUSE.

Some provision will be required for stocking and maintaining the plant house.

It may be rendered useful in two ways, according to treatment. In the first place, it may be used to display the peculiarities of the different families of plants, and to furnish a means of illustration and practice in plant house management for the students. These will be the most obvious and ordinary purposes. But the plant house is a feature of the Department that will be seen by every one who visits the University. With many of these visitors, it will stand as the representative of the whole Department, and if kept in the very best of condition, and furnished with the choicest of plants, a corresponding impression will be made. It will indeed be the show feature of the College of Agriculture, while the other appurtenances, except the museum, will be seen by a comparatively few.

The donations to this Department the past year have been quite numerous. The following is a nearly complete list:

Mr. Hale, Iowa, fruit trees.
A. Stewart, Richfield, fruit trees and plants.
J. F. True, St. Paul, seeds.
F. G. Gould, Excelsior, potatoes.
E. B. Jordan, Rochester, fruit trees.
J. C. Kramer, LaCrescent, fruit trees, plants and vines.
O. D. Storrs, Winsted Lake, cions.
W. E. Brimhall, St. Paul, fruit trees and plants.
T. Tunis Smith, St. Paul, potatoes.
Truman M. Smith, St. Paul, potatoes, fruits and photographs for museum.
J. W. Boxell, Afton, fruits for museum.
Wyman Elliot, Minneapolis, fruits for museum.
Hon. Geo. A. Brackett, greenhouse plants.
A. W. Sias, Rochester, fruit trees.
J. H. White, Crystal Lake, fruit trees and cions.
L. D. Mills, Garden City, fruit trees.
R. W. Woodville & Co., Northfield, Minn.; R. H. Allen & Co., New York City; J. H. Gregory, Marblehead, Mass.; B K. Bliss & Sons, New York City; Jas Vick, Rochester. N. Y., discounts on bills of seeds.
Gorham Powers, Yellow Medicine, seeds.
I. H. Moulton, Minneapolis, fruit trees and plants.
Wm. H. Ferguson, Excelsior, seeds.
Bryant & Elder, Derby Centre, Vt., fruit trees.
J. S. Brockelhurst, Princeton, seeds.
W. T. Scott, Minneapolis, seeds.
Levi Brigham, Osseo, seeds.
W. J. Abernethy, Farmers' Union for 875.

ACKNOWLEDGMENT.

In the labors of the farm, gardens, etc., special acknowledgment is due to Mr. W. T. Scott, superintendent of the farm, for his active and enthusiastic assistance in the development and management of those divisions as well as for some of the notes on which portions of this report are based.

LECTURE COURSE FOR FARMERS.

A course of lectures for farmers was offered in the University calendar, provided thirty persons, not members of the University, should pledge themselves to attend. But very few pledges, not over half a dozen, could be obtained, and so the course has not been prepared for.

I however still have faith in its great value, and would suggest that the same offer be made again next year, and more widely ad-

in this collection.
his report, that the Agricultural De-
substance.

Respectfully submitted.

CHARLES Y. LACY.



UNIVERSITY OF MINNESOTA,

BEING CHIEFLY

THE TAPPAN COLLECTION,

COMPLETE TO FEBRUARY, 1875.

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2. The volumes then receive their proper labels and numbers, and the catalogue slips having been written out, they are ready for delivery to readers.

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4. The system of shelf marking will be readily inferred from one or two examples. 364.13, indicates the thirteenth *work* on the fourth shelf, of case or press number 36. To find the work "pressmarked" 76.8, go to press number 7 and look on the 6th shelf—counting from the floor upwards—and for the 8th work, numbering from the left hand.

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ABERT, J. J. *See* Fremont, J. C. (4068) 213.16

ABOUT, Edmond. The Roman Question. Translated from the French by H. C. Coape. New York: D. Appleton & Co.,....1859. 16mo. pp. 219. (4074) 216.27

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Vol. II, The Faithful Shepherdess. The Knight of the Burning Pestal. A King and no King. Cupid's Revenge. The Masque of the Inner-Temple and Gray's Inn. Four plays in one.

Vol. III, The Scornful Lady. The Coxcomb. The Captain. The Honest Man's Fortune. The little French Lawyer.

Vol. IV, Wit at several weapons. Wit without Money. The Faithful Friends. The Widow. The Custom of the Country.

Vol. V, Bonduca. The Knight of Malta. Valentinian. The Laws of Candy. The Queen of Corinth.

Vol. VI, The Loyal Subject. The Mad Lover. The False One. The Double Marriage. The Humorous Lieutenant.

Vol. VII, Women Pleased. The Woman's Prize. The Chances. Monsieur Thomas. The Island of Princess.

Vol. VIII, The Pilgrim. The Wild-Goose-Chase. The Prophetess. The Sea Voyage. The Spanish Curate.

Vol. IX. Beggars' Bush. Love's Cure. The Maid in the Mill. A wife for a month. Rule a Wife and have a Wife.

Vol. X, The Fair Maid of the Inn. The Noble Gentleman. The Elder Brother. The nice Valour; or, The Passionate Madman. The Bloody Brother; or, Rollo, Duke of Normandy.

Vol. XI, Lover's Progress. The Night-Walker: or, The Little Thief. Love's Pilgrimage. The Two Noble Kinsmen. Poems by Beaumont. Poems by Fletcher. Index to the notes.

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Contents:—Vol. I, Book I, Of Names and Propositions. Book II, Of Reasoning. Book III, Of Induction. Vol. II, Of Induction, continued. Book IV, Of Operations Subsidiary to Induction. Book V, On Fallacies. Book VI, On the Logic of the Moral Science.

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THE GEOLOGICAL

AND

NATURAL HISTORY SURVEY

OF

MINNESOTA.

THE FOURTH ANNUAL REPORT.

FOR THE YEAR 1875.

By N. H. WINCHELL, State Geologist

ASSISTED BY

M. W. HARRINGTON, of the University of Michigan.

SUBMITTED TO THE PRESIDENT OF THE UNIVERSITY, DEC. 31, 1875.

SAINT PAUL:
THE PIONEER-PRESS COMPANY.
1876.

STATE PUBLICATIONS RELATING TO THE GEOLOGY OF MINNESOTA.

1. *Sketch of the Lead Region, by Dr. D. F. Weinland, with a statement of the objects of a geological and natural history survey.* 84 *pp.* 1860. *Reprint from the Wisconsin Reports for* 1858. *Out of print.*
2. *Statistics and History of the Production of Iron, by A. S. Hewitt.* 47 *pp.* 1860. *Reprint of a paper read before the American Geographical and Statistical Society, January* 31, 1856. *Out of print.*
3. *Report of Anderson and Clark, Commissioners on the Geology of the State, January* 25, 1861. 8*vo.* 26 *pp. Out of print.*
4. *Report of Hanchett and Clark, November,* 1864. 8*vo.* 32 *pp. Out of print.*
5. *Report of H. H. Eames, on the Metalliferous Region bordering on Lake Superior,* 1866. 8*vo.* 28 *pages.*
6. *Report of H. H. Eames, on some of the northern and middle counties of Minnesota.* 1866. 8*vo.* 58 *pp. Out of print.*
7. *Report of Col. Charles Whittlesey on the Mineral Regions of Minnesota.* 1866. 8*vo.* 52 *pp. close type, with wood cuts.*
8. *Report of N. C. D. Taylor on the Copper District of Kettle river, incorporating Mr. James Hall's estimate of the copper prospects of that district,* 1866. 2 *pp.* 8*vo. Found only in the Executive Documents.*
9. *Report of a Geological Survey of the vicinity of Belle Plaine, Scott county, Minnesota. A. Winchell. June* 17, 1871. 8*vo.* 16 *pp.*
10. *The First Annual Report on the Geological and Natural History Survey of Minnesota, for the year* 1872. *By N. H. Winchell.* 8*vo.* 112 *pp. with a colored geological map of the State. Published in the Regents' Report for* 1872. *Out of print.*
11. *The Second Annual Report on the Geological and Natural History Survey of the State, for the year* 1873. *By N. H. Winchell and S. F. Peckham. Regents' Report;* 148 *pp.* 8*vo*; *with illustrations.*
12. *The Third Annual Report on the Geological and Natural History Survey of Minnesota, for the year* 1874. *By N. H. Winchell.* 41 *pp.* 8*vo. with two county maps. Published in the Regents' Report for* 1874.

[NOTE.—Of the foregoing, Nos. 1, 2, 4 and 6 are wanted by the Survey.]

ADDRESS AND SUMMARY STATEMENT.

To the President of the University:

The accompanying report, the fourth since the beginning of the Geological and Natural History Survey of the State, embraces full and detailed reports on the counties of Fillmore, Olmsted, Steele and Dodge. These counties lie nearly contiguous in the southeastern portion of the State, embracing some of the first settled, and now most thickly inhabited counties of the State. The plan for the season embraced other counties, in the central portion of the State, and one or more in the northern. But it has been found impossible to complete more than the four named. Considerable work has been done in Hennepin county, and some in Stearns, but the scattered observations made will be reserved till the work in those counties is taken up and reported in detail. The complicated character of the work done in Fillmore and Olmsted counties will be seen by a glance at the accompanying geological maps of those counties. The eastern portion of these counties, particularly Fillmore, falls within that well-known tract denominated by Prof. J. D. Whitney, a "driftless area." This term very nearly describes the tract as represented in this portion of Minnesota, but I have been able to discern, even in the most eastern part of Fillmore county, occasional small deposits of true northern drift, as detailed by localities in the report on that county. In the absence, or attenuation, of the true northern drift, the underlying rocks make bold and frequent outcrops, governing the immediate contour of the surface, and deciding the agricultural as well as the general industrial resources of the country. It has been necessary, therefore, to give very minute attention to the lines of outcrop of the different formations as they make their way across the county, in order to delineate them correctly on the accompanying colored maps.

In the survey of these counties I have had the assistance of Mr. W. E. Leonard, a student of the University, who accompanied me in the earlier part of the season in Fillmore county, and of Prof. M. W. Harrington, of the University of Michigan, whose report is

herewith presented. Prof. Harrington, who ably carried on the work independently in my absence, was compensated only by the payment of his field and traveling expenses. He also had the privilege of retaining such botanical specimens as he could gather, for the purpose of enlarging the already magnificent collection of plants in the museum of Michigan University, a list of all identifications being reported for our survey.

The catalogue of the plants of the State, by Dr. I. A. Lapham, mentioned in the report for 1873, has been printed by the State Horticultural Society, and is published in its report for 1875, where it is duly accredited to the Geological and Natural History Survey, to whose care Dr. Lapham had entrusted it.

In December, 1872, the Board of Regents adopted a resolution asking the representatives and senators in Congress, from Minnesota, to take measures to secure to Minnesota such determinations of latitude and longitude, by the United States Lake Survey, as are done in other States by the officers of that survey. Through the co-operation of Hon. M. H. Dunnell, representative in Congress, the Superintendent of the Lake Survey, Gen. C. B. Comstock, was induced to take immediate steps toward the determination of the latitude and longitude of the University buildings. There being no Congressional appropriation for further determinations in this State, nothing further has been done. It is desirable, in order to construct a correct map of Minnesota, that as many points as possible be established in the same manner. In the State of Michigan, the Lake Survey officers are determining one or more points in each county of the Southern Peninsula. It is done by special act of Congress, appropriating money to enable the Lake Survey to aid the State Survey. I call your attention to this matter, that further efforts may be made to carry out the intent of the original action of the Board of Regents. It is the established policy of the general government to aid those States that are carrying on geological surveys, through the instrumentality of the coast surveys, and it has been so announced. The attention of Congress should be called specially to this matter, in order that our survey may receive its share of such aid.

The following has been sent from the office of the Lake Survey, at Detroit, by order of Gen. Comstock, giving the results of observations made at the University:

Longitude of the Smaller Cupola of the University of Minnesota.

	Longitude.	References.
Longitude of Washington (Naval Observatory) west from Greenwich.	77° 03′ 00″. 00	Admiral Sand's letter, February 9, 1872.
U. S. Lake Survey observatory (1857 to 1870) west from Washington (Naval Observatory.)	5 59 59. 80	L. S. Report 1871 and Office No. 8.
S. E. corner of the new Custom House, St. Paul, Minn., west from the L. S. Obs. (1857 to 1870.)	10 02 32. 25	L. S. Report 1872 and Office No. 8.
Smaller Cupola of the University of Minnesota west from the S. E. corner of the new Custom House.	0 8 36. 50	See office rept. No. —. A. R. Flint, obs'r. T. Russell, computer.
Longitude of the smaller cupola of the University of Minnesota from Greenwich.	93° 14′ 08″. 60	

	Latitude.	References.
Latitude of the S. E. corner of the new Custom House.	44. 56 42. 89	Office No. 8, from A. R. Flint, observer, 1871.
Smaller Cupola of the University of Minnesota north from the S. E. corner of the Custom House.	1 56. 33	Office rep. No. 213. A. R. Flint, ob'r, T. Russell, c'p'r.
Smaller Cupola of the University of Minnesota.	44° 58′ 39″. 22	

	Latitude.	Longitude.
Smaller Cupola of the Univ. of Minnesota	44° 58′ 39″. 22	93° 14′ 08″. 60

(Signed) O. B. WHEELER,
Compiler.

In regard to chemical work I am not informed that anything has been done since the report of 1873. From time to time the following substances have been submitted to the chemist of the survey for examination. This list is here given that the records of the survey may be easily consulted, and that in future analyses samples may readily be referred to their sources.

No. 1. Light, pinkish clay, known as "Tripoli," from Stillwater, Minn. Submitted to Prof. Strange December 10th, 1872. Reported on by Prof. Peckham. (See the Second Annual Report.)

No. 2. Red and yellowish clay, fine grained; no apparent pebbles nor sand. From Spring Valley, Minn. Submitted to Prof. Strange December 10th, 1872.

No. 3. Drab, or brown clay, with a reddish tinge, very fine and soapy to the touch; no sand nor pebbles. From Spring Valley, Minn. Submitted to Prof. Strange December 10th, 1872.

No. 4. Same as No. 2, but evidently arenaceous, and with occasional small pebbles. From Spring Valley, Minn. Submitted to Prof. Strange December 10th, 1872.

No. 5. Peat, from Schmidtz' land, St. Paul, Minn., eight feet below the surface. Submitted to Dr. P. B. Rose August 6th, 1873. Reported November 22d, 1873. (See the Second Annual Report.)

No. 6. Peat, from Schmidtz' land, St. Paul, Minn., 2 feet below the surface. Submitted to Dr. P. B. Rose August 6th, 1873. Reported November 22d, 1873. (See the Second Annual Report.)

No. 7. Manufactured Peat, from Wells; W. Z. Haight. Submitted to Dr. P. B. Rose, August 6th, 1873. Reported by him November 22d, 1873.

No. 8. Peat from Lake Emily, near St. Peter, Minn. Submitted to Dr. P. P. B. Rose, August 6th, 1873. Reported November 22d, 1873.

No. 9. Turf-peat, from Empire City. Submitted August 6th, 1873, to Dr. P. B. Rose. Reported November 22d, 1873.

No. 10. Peat from Wells, not manufactured. Submitted August 6th, 1873, to Dr. P. B. Rose. Reported November 22d, 1873.

No. 11. Cretaceous coal, cannel, from Crow Creek, near Redwood Falls, Minn. Submitted to Prof. S. F. Peckham, Sept. 6th, 1873.

No. 12. Coal, from the surface, near Bismarck, D. T. Submitted to Prof. S. F. Peckham, September 6th, 1873. [The last two have the same external characters.]

No. 13. Earthy coal, from Crow Creek, near Redwood Falls, Minn. Submitted to Prof. S. F. Peckham, September 6th, 1873.

No. 14. A mixture of charcoal and ash, apparently, from the lignite beds of the cretaceous, at Redwood Falls, Minn. Submitted to Prof. S. F. Peckham, September 6th, 1873.

No. 15. Kaolin; the result of decomposed granite, greenish, with no apparent grit. From Birch Coolie, Minn. Submitted to Prof. S. F. Peckham, September 6th, 1873. (See description of this substance, and of the locality, in the Second Annual Report.)

No. 16. Peat, from St. Cloud, 18 inches below the surface. Submitted to Prof. S. F. Peckham, September 15th, 1873. Partially analyzed and reported December 23d, 1873.

No. 17. Peat from Lura, Faribault county, Minn., 18 inches below the surface. Land of W. Z. Haight. Bog A. Submitted to Prof. S. F. Peckham, October 9th, 1873. Partially analyzed and reported December 23d, 1873. (See the Second Annual Report.)

No. 18. Peat from the same bog as No. 17, 3 feet below the surface. Submitted to Prof. S. F. Peckham, October 9th, 1873. Partially analyzed and reported December 23d, 1873.

No. 19. Peat from Lura, Bog B, 18 inches below the surface. Submitted October 9th, 1873, to Prof. S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 20. Peat from the same bog as No. 19, 3 feet below the surface. Submitted to Prof. S. F. Peckham, October 9th, 1873. Partially analyzed and reported December 23d, 1873.

No. 21. Turf-peat, from the land of John Haggard, section 4, town 101, range 39. Submitted October 9th, 1873, to Prof. S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 22. Peat from K. K. Peck's land, near Windom, 3 feet below the surface. Submitted October 9th, 1873, to Professor S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 23. Peat from K. K. Peck's land, near Windom, 2 feet below the surface. Submitted October 9th, 1873, to Professor S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 24. Peat, from the land of Rev. Edward Savage, near Windom, Minn., 18 inches below the surface. Submitted October 9th, 1873, to Prof. S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 25. Turf-peat, from S. O. Taggart's land, section 24, town 105, range 35. Submitted October 9th, 1873, to Prof. S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 26. Peat from land of A. A. Soule, Mountain Lake, Minn., 2 feet below the surface. Submitted October 9th, 1873, to Professor S. F. Peckham. Partially analyzed and reported December 23d, 1873.

No. 27. Peat from the land of the St. Paul and Sioux City Railroad, section

13, town 106, range 37, 2 feet below the surface. Submitted to Prof. S. F. Peckham, October 9th, 1873. Partially analyzed and reported December 23d, 1873.

No. 28. Peat from the land of F. G. Taylor, Brooklyn, Hennepin county. Submitted to Prof. S. F. Peckham, October 9th, 1873. Partially analyzed and reported December 23d, 1873.

No. 29. Lumps from the sandstone near the Red Jacket Mills, in Blue Earth county, apparently magnesia, or magnesia and lime. (See description of that locality in the report for 1873.) Submitted to Prof. S. F. Peckham. Partially examined and reported December 23d, 1873.

No. 30. Green specks in the *St. Lawrence limestone*. Sample from St. Lawrence. Submitted to Prof. S. F. Peckham. Partially examined and reported December 23d, 1873.

No. 31. Green specks from the *St. Lawrence limestone*. Sample from Judson. Submitted to Prof. S. F. Peckham. Partially examined and reported December 23d, 1873.

No. 32. Black mineral, accompanying quartz. The quartz occurs in decomposed granite, at Minnesota Falls. The mineral has the appearance of specular peroxide of iron, but is thought by the owners to be a mineral of value. Submitted to Prof. S. F. Peckham, who pronounced it haematite iron ore. (See the description of this locality in the Second Annual Report.)

No. 33. Turf-peat, town 101, range 40, section 27. Submitted to Prof. S. F. Peckham, March, 1874.

No. 34. Peaty lake sediment, Bigelow, Minn. Submitted to Prof. S. F. Peckham, March, 1874.

No. 35. Peat, from Red Wing, land of Capt. O. Eames. Submitted to Prof. S. F. Peckham, March, 1874.

No. 36. Peat from C. F. Bryan's land, near Winona, Minn. Submitted to Prof. S. F. Peckham, March, 1874.

No. 37. Ore from the Sauk Valley, said to have been taken from the bottom of a shaft sunk in exploration for coal. Submitted to Prof. S. F. Peckham.

No. 38. Ore, supposed to be of silver, from Colorado, from J. B. Culver. Duluth, Minn. Submitted to Prof. S. F. Pechham, September 15th, 1874. Reported to Mr. Culver.

No. 39. Ore, supposed to be of silver, from E. F. Kindred, Brainerd, Minn. Submitted to Prof. S. F. Peckham, September 18th, 1874. Reported to Mr. Kindred.

No. 40. Ore, supposed to be of silver, from the north shore of Lake Superior, near Duluth, from H. Burg. Submitted to Dr. P. B. Rose, November 20th, 1874. Reported December, 1874, and forwarded to Mr. Burg.

No. 41. Ore from M. L. Casey, supposed to be of iron, from the corporate limits of Duluth. Submitted to Prof. S. F. Peckham, December, 1874.

No. 42. Sample of mineral water from the Belle Plaine Salt Springs. Submitted to Prof. S. F. Peckham, October, 1873. Partially analyzed and reported December 23d, 1873.

No. 43. Fragment of native copper, apparently, from R. S. Russell, Pleasant Grove, Olmsted county. Submitted to Mr. D. P. Strange in the winter of 1872 and '73. Reported by Prof. S. F. Peckham, December 23d, 1873.

No. 44. Sample of water from the Belle Plaine Salt Springs. Submitted to Prof. S. F. Peckham, October, 1873. Partially analyzed and reported February 16th, 1874.

The accompanying report also embraces a statement of operations in the Museum since the date of the last report thereon. The law ordering the Geological and Natural History Survey contains a clause as follows:

SEC. 6. It shall be the duty of said board of regents to cause

proper specimens, skillfully prepared, secured and labeled, of all rocks, soils, ores, coals, fossils, cements, building-stones, plants, woods, skins, and skeletons of animals, birds, insects and fishes, and other mineral, vegetable and animal substances and organisms discovered and examined in the course of said surveys, to be preserved, for public inspection, free of cost, in the University of Minnesota, in rooms convenient of access, and properly warmed, lighted, ventilated and furnished, and in charge of a proper scientific curator. * * *

This clearly establishes in the University a State Cabinet or Museum of Natural History. A report on the progress of the survey, in compliance with law, implies a report on the condition of its collections. Hence it seems proper that hereafter the report on the museum should be embraced in that on the progress of the survey. With the establishment of the State Museum at the University arises the necessity for cases for the exhibition and proper keeping of the collections, and other current expenses involved in their transportation, labeling and custody. Objects of Natural History, requiring careful and often expensive preparation, must be constantly watched and frequently cleansed, to prevent their deterioration and destruction. The mounting of mammals and of birds is expensive. To carry on a system of exchanging, with other institutions, as ordered by the law, involves an outlay of money. None of these expenses have been provided for. The legislature should make an annual appropriation of several hundred dollars to enable the Regents to carry out that part of the law. It will require, at once, about a thousand dollars to fit up the rooms assigned to the use of the Museum, with suitable cases and other appliances.

I wish to call to your serious attention, the propriety of taking steps to place on an active footing other portions of the work ordered by the general law of March, 1872. Sundry practical questions involving the industries of the state and the confort of the people, have arisen since the inception of the survey; and the demand for their solution, by efficient means and in an authoritative manner, has sought expression in attempts at special legislation, creating special commissions for the purpose of investigation and report. These practical questions, which really depend, in their ultimate results, on the means taken to investigate under the guide of science, and to modify or control their operations, are covered by the terms of the general law of March, 1872. I refer to an examination of the peat deposits, and to the collection of statistics concerning the late incursion of the western grasshoppers into the state. If the general law were put into vigorous execution, with ample means, there would be no inducement to originate special commissions to perform the various portions of the work ordered. It seems to me these departments ought not to rest much longer without making a systematic beginning. If nothing more is done than to keep up an organization, with little expense, such organization would be ready in case any public emergency arises to take the work in hand, and to furnish information immediately concerning its proper treatment. In the mean time, any special commission, created to perform work


TA.
Counties.
miles.
SSIONS
Rainy L.
Hunters I.
Vermilion L.
LAKE
ST. LOUIS
Mining Distric
LAKE SUPERIOR
Duluth
U.S.L.H.
CARLTON
N.P.R.R. EXT.
PINE
Chengwatana
St Croix R.
Rush City
NORTH WISCONSIN R.R.
St Croix Falls
Taylor's Falls
U.S.L.D.
Stillwater
Hudson
Prescott
LAKE PEPIN
WEST. & GREEN BAY
WISCONSIN R.
MISSISSIPPI R.
Cannon R.
Zumbro R.
Rochester
WINONA
DODGE
OLMSTED
MOWER
FILLMORE
HOUSTON
WISCONSIN



EPORT ON THE GEOLOGY OF FILLMORE COUNTY.

Situation and Area.

illmore county lies adjacent to the State of Iowa, and is sepad from the Mississippi river by Houston county. It lies next t of Mower county, which was reported on last year. It has a dth, north and south, of four government towns, each six miles are, and a length, east and west, of six, making it one of the gest of the organized counties. Its area is about 864 square les, or 553,081.77 acres, according to the records of the State nd Office. It contains no lakes, and but few acres that are united to farm tillage. Preston is the county seat. Lanesboro, ring Valley, Chatfield and Rushford are the principal towns.

Natural Drainage.

Root river, with its tributaries, drains nearly the whole of the nty. The Upper Iowa river, which enters the county in Beaver d Bristol townships, receives a few small streams from the south- tier of townships. Root river, flowing toward the east, spreads its tributaries north and south, like the rays of a fan, crossing entire county from west to east. Many of the branches of Root er rise in the counties next west and north of Fillmore county, a tract of country covered with northern drift. After entering llmore county, they soon enter canon-like valleys, and the drift comes much lighter. They then converge toward the main val-, following deeply cut rocky valleys, and leave the county in one ame at Rushford, in the northeastern corner of the county. These eams furnish frequent water-power privileges, and a number of e have been improved in the erection of mills, which are scattered oughout the county as follows. There are, besides these, several aller saw mills:

Chatfield, two flouring mills.
the southeast quarter of section 17, Chatfield, one flouring mill.
Clear Grit, one flouring mill.
section 31, Jordan, one saw mill.
Preston, one flouring and one woolen mill.
Carimona, one flouring mill.

At the Tunnel Mills, section 34, Sum
ken of the winding course of Bear Creek
both sides by high rocky walls. A tur
narrow neck, excavated in the rock, adn
again into the river, on section 34, prod
feet. The cut in the rock is 600 feet l
feet for the tail race. At G. Weisbeck's
is offered. This is on section 11, Spri
70 feet, through the "Hog's back," a f
be secured; and at the lime kiln of Mr.
a tunnel of 125 feet will furnish a power
from Weisbeck's, a tunnel of 450 feet
water. The rock is limestone, in horizo

Surface Featu

That portion of the county which is c
of foreign drift presents the usual mon
istic of the drift latitudes. This includ
range of townships across the western e
portions of the next range east. Ther
the drift area, a number of narrow, dee
itous, rocky bluffs, having very much
those of the driftless territories of tl
these deeply cut valleys are more numer
and a great many narrow valleys that
them, have high, rocky bluffs along thei
lies and streams, constituting the drai
converge toward the valley of Root
stream with its principal tributaries

Trenton a deep channel from 15 to 30 miles in extent. Through the line of strike of the St. Peter these valleys are widened out, the surface of the low ground within the bluffs being usually one of rich meadow with undulating surface, from one to two hundred feet below the general level. The Lower Magnesian Formation is entered upon by the streams while they are yet a good many miles within the general area of the Trenton. As this formation consists of three members. (two limestones, separated by a sandstone about 30 feet in thickness,) it repeats the succession of phenomena witnessed in the erosion of the Trenton and St. Peter. As the water leaves the Shakopee limestone and enters upon the Jordan sandstone, it passes over a series of rapids, or a fall of several feet perpendicular, which falls or rapids undergo a process of recession under the same causes as produce the recession of the Ttrenton-St. Peter falls. Again, when the stream passes from the St. Lawrence limestone upon the St. Croix sandstone the same conjunction of circumstances causes another rapid or water-fall. Thus by a series of steps, more or less evident, the branches of Root river descend from the area of the Galena limestone to the St. Croix sandstone. The valleys widen in the sandstone areas, and become abruptly narrow in the limestone belts. In passing down a stream, within a sandstone area, where the valley is perhaps half a mile wide, with tilled farms in the bottom land, the high bluffs being remote from the stream, the first indication of an approaching change in the formation is the rise of a terrace along the immediate river bank, with an occasional exposure of lime rock facing the water. This terrace, which becomes almost continuously rocky, rises slowly till it exposes the full thickness of the rock which causes it. On the other hand, the first evidence of a change from limestone to sandstone, visible in descending the stream, is the occurrence of a waterfall or rapid. Such changes produce water-powers, many of which have been improved. Hence, the location of a flouring mill, on one of these branches, is an intimation to the geolgist that at that point one of his boundary lines crosses that stream. Around these points gathered the first village settlements. Preston is located where the water-power formed by the descent of the river from the Shakopee on to the Jordan induced the construction of mills. The water-power at Chatfield is formed in the same way. Near Fillmore the branches of Root river, known as Deer and Bear creeks, afford good water powers by their descent from the lower Trenton to the St. Peter. Mills have been built at both points. On the south branch of Root river, above Forestville, the stream leaves the Trenton, and the waterfall has been improved in the same manner, at Baldwin's Mill. The same fact is illustrated by a great number of eastward flowing streams, in the eastern border counties, between Fillmore County and the falls of St. Anthony at Minneapolis. Of course, rapids are also likely to be formed, especially in small streams, when passing through the areas of rock of uniform hardness. Such water-powers, and others that are formed by the construction of dams, do not fall into this class.

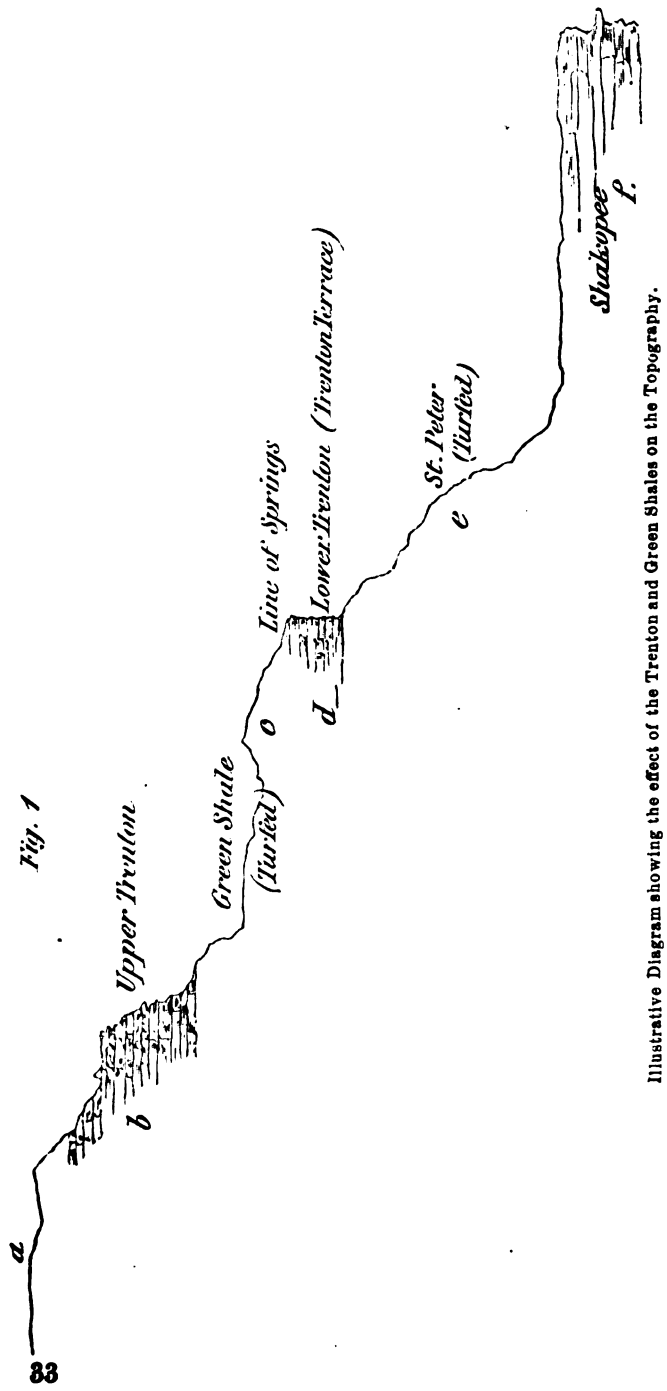
While the immediate valleys of Root river and its tributaries are to be rocky, the country that spreads out in either direction,

terrace, about 125 feet. Some of the front
the main area, and constitute small tables
known as "Trenton mounds" in the early
have referred them to the agency of the ai
and a good many of the residents, who are
ical causes that have produced them, st
artificial instead of natural. From some
areas, overlooking the river valleys, magni
may be had. From the elevated Trenton
ship, the eye looks over the valley of S. R
discern the Trenton bluffs on the opposite
the northern part of the county. From th
running north between Camp and Willow
ship, the village of Fountain is plainly disc
of the S. Branch of Root river and Watso
panse of alternating timber and prairie bet
is a broad undulating valley of prairie lan
creek valley, and on the west is that of Wil
are deep and wide, but owing to the thick
the slopes are gentle and broad, and, in th
the industry of the farmer is exhibited in
fields, and the threshing of his last crop, i
heard the rattle of threshers, often runnir
seen a hundred teams preparing for the
magnificent view may be obtained from th
secs. 10 and 15 in Carrollton. From here
over the valley of Root river to the Trento
boundary of the county, a distance of over
the south over the valley of the S. Branc
over Preston and Lanesboro, which are s
bluffs, so far below the general level of th
be seen but a short distance before reachi

440 feet below the top of the Trenton terrace on sec. 20, Holt. At Preston the river at the stone mill is 335 feet below the Trenton terrace, which forms the general level about a mile south of the village. At Isinours Station the river runs 145 feet below the top of the Shakopee limestone which forms there the brow of the immediate river bluffs. At Forestville, the height of the country, north of the village, above the river, is 285 feet. The immediate river bluffs are 190 feet above the mill pond. At Chatfield, the river is about 222 feet below the general level of the country. At Fillmore, the prairie upland is 200 feet above the river level. From Fountain to Isinours station, the track of the Southern Minnesota railroad descends 401 feet, passing from the upper Trenton to the St. Lawrence, and entering the latter formation about 25 feet, the rocks all lying nearly horizontal At Weisbeck's Mill, on Deer Creek, section 11, Spring Valley, the river is 205 feet below the general level of the country. There is here a little drift, but the cut is mostly in the Galena and Trenton limestones. The village of Fountain is about 350 feet higher than the terrace, at Preston, on which the Stanwix House stands. These measurements might be multiplied, but enough have been given to show the unevenness of the surface, due to erosion. The rocks lie everywhere nearly horizontal. The varied topography of the county is due to the influence of running water, and atmospheric forces, on the rocks, combined with their alternations of limestone with soft sandstone. The limestones are firm, and resist these forces much longer than the sandstones, They alternate in the following manner, in descending order:

Trenton limestone.
St. Peter sandstone.
Shakopee limestone.
Jordan sandstone.
St. Lawrence limestone.
St. Croix sandstone.

The limestones form the prominent features in the topography. They have the most frequent outcrops. They project along the summits of the bluffs, and constitute the brows of benches or terraces that diversify the county. The sandstones never, or very seldom, appear in the tops of the bluffs. They outcrop in sheltered nooks, or below the line of the limestone exposure. They are more likely to be hid by soil and turf. The lower Trenton contains, besides about 20 feet above the St. Peter sandstone, a layer of easily eroded green shale, which, outcropping by roadsides, introduces a series of springs and muddy spots, being impervious to water, that invariably follows that boundary line wherever it goes. It withstands the disintegrating action of the elements even more successfully than the limestones themselves. For that reason it protects that portion of the Trenton which lies below it, long after that which lies above it has been entirely denuded. The strike of the upper Trenton is often driven back several miles from that of the lower Trenton. The lime rock which lies below this shale is about 20 feet thick. The singular Trenton mounds, which have already been



Illustrative Diagram showing the effect of the Trenton and Green Shales on the Topography.

At *a* the Trenton has its full thickness, about 160 feet. Such point may be found at Fountain; *b* represents an outcrop of th upper Trenton, as seen along the gorges that are frequent in th Trenton area. Such an outcrop is visible at the "Big Spring," few miles northwest of Fountain, where the water rushes out in great volume near the base of the bluff, and probably on a lev with the top of the Green Shale. At *c* is a marshy tract, or on that is gently sloping, having a springy margin, near the brow o the lower bluff. Such spots are visible particularly at Chatfield, i the northern part of the village, near Jacob's lime-kiln, and west o there. A fine illustration of the effect of this shale on the surfac drainage may be seen in section 35, Holt, where a copious sprin issues from near the top of the mound of Trenton, the water bein shed by the shale overlying, and is gathered by troughs into a tan for watering stock. *d* represents the outcropping edge of th lower Trenton, It is this which is seen in the summits of the iso lated mounds, and which forms the conspicuous shoulder that exist wherever the strike of the lower Trenton crosses the county. Th slope *e* is occupied by the St. Peter sandstone. Sometimes this i quite precipitous, and its upper forty or fifty feet are very apt to be but its lower portion is generally very gently descending, so that i is impossible to determine when it is replaced by the Shakope which underlies it. The horizontal distance between *b* and *d* i sometimes several miles. This is apt to be the case along the east ern margin of the Trenton area. Indeed the detached Trento areas in Holt and Amherst, and notably that in Pilot Mound, town ships, comprise only this lower portion of the Trenton. The Shak opee limestone, *f*, underlying the St. Peter, is that which occur along the tops of the immediate bluffs of the river, as at Preston Lanesboro, Clear Grit and Whalen. At Chatfield it is seen at th mill, and rises about thirty feet above the river.

Throughout the Trenton area are found a great many depression that are well known as "sink-holes." These consist of broke down spots in the drift, or loam, where it had been spread over pre-existing canon in the rock. In some places they are very nu merous, but they are confined, so far as known, with but a sing exception, to the Trenton areas. They throw some light on th condition of rocky surface prior to the period which witnessed th spreading of the drift. The rock was wrought, at least in Fillmo county, in very much the same manner as we now see it along t river gorges. The immense valleys of erosion which we see, n only in Fillmore county, but also throughout the tract that has be denominated the "Driftless area," were excavated before the glac period. When the streams of the present time run in such gorg they have been so located by the exigencies of surface drainag and erosion since the glacial epoch. That these gorges anteda the glacial period is shown by their existence beneath the glac drift. These sink-holes sometimes occur in lines, and with increa ing frequency and size toward a large valley, and at last coales so as to form a continuous valley, though frequently without ru ning water, that becomes tributary to the larger gorge. The gorges under the drift can sometimes be traced for some distan

by a series of successive sink-holes. Sometimes streams are lost in them, and reappear at lower levels. There are several well-known subterranean passages in the county. Lost Creek, in Jordan township, and the Brook Kedron, in Sumner, both have underground passages for several miles. Canfield Creek, south of Forestville, runs underground about twelve miles, and, finally, the south branch of Root River sinks on the northeast quarter of section 19, Forestville, and runs underground, except in high water, to about the center of section 21, where it reappears again. These underground passages are in the area of the Trenton. They indicate the corrugated surface the country presented prior to the overspreading of the drift and loess loam. The Trenton cannot be supposed to have been any more subject to such causes as produced this channeling in the rock than the other formations of the Lower Silurian. There is some reason, however, why these gorges are found almost entirely confined to that limestone. As has been said, the rest of the Lower Silurian consists of alternating sandstones and limestones, which conduces to their breaking down laterally, the sandstones easily crumbling out. The Trenton limestone, on the other hand, while it has a thickness of 160 feet, more or less, has, near its base, a bed of impervious shale, which prevents the downward infiltration of the surface water, and protects the underlying sandstone. Hence the erosions that operate laterally, in tearing down the other Lower Silurian formations, are occupied, in the Trenton limestone area, in cutting narrow perpendicular gorges. For this reason the Trenton area is everywhere the highest in the county. From the eastern boundary of the Trenton, looking east, one beholds a broad landscape lying several hundred feet, in some places, below him, the effect of the more rapid denudation of the rocks of that portion of the county. Into such narrow gorges neither the drift nor the loess loam, however deposited, would enter with such compactness as to close up the pre-existing water courses; and when partially closed up, as they were wherever sink-holes have since appeared, they have been undergoing ever since a process of re-excavation. This process is revealed in the occasional collapsing of the surface soil, and the formation of a new sink-hole, and in the enlargement of others, since the settlement of the county. The following notes on the various towns of the county show the distribution of timber, the area and the magnetic variation at the time of the United States township survey (1854.) The distribution of timber, however, as herein noted, varies somewhat from the actual facts as existing at the present time. The areas of timber as they exist now, are more correctly shown on the accompanying map, which is based on that of the county published in Andreas' Atlas of Minnesota.

In addition to the timbered areas as here noted, a great proportion of the county is covered with bushes which are composed of hazel, aspen, oak (two sorts) and, where these are wanting, a species of low willow which seems to come up first after the prairie fires are stopped. After the willow, hazel and oak and aspen gradually come in, and in time convert the original prairie to a bushy or timbered region. Over a great deal of the county this process is

going on. There are thousands of acres of young native timber not exceeding five or six inches in diameter.

The general elevation of the county above the sea may be seen from the following points along the Southern Minnesota R. R.:

Rushford Depot	711 feet.
Lanesboro Depot	831 feet.
Isinour's Station	888 feet.
Fountain Depot	1,289 feet.
Grand Meadow, Mower County	1,325 feet.

Notes from the Surveyor's Plats of Towns of Fillmore Co.

Newburg. T. 101 *N., R.* 8 *W.*

A large portion of this town is prairie. In the N. W. corner the S. Branch of Root river introduces a broken and wooden tract in secs. 6, 5 and 4. Thickets of small timber are found in the central and southwestern portions, and also in the northeast. Magnetic Variation 4° 45′ to 9° 22′. Area, 23,045.54 acres.

Preble. T. 102 *N., R.* 8 *W.*

This town is mainly wooded. It is crossed in the northeasterly direction by the south branch of Root river, which, with its tributaries brings in a great diversity of surface. There is a small prairie patch in sections 25, 26, 34, 35 and 36. Magnetic Variation 6° 10′ to 9° 12′. Area, 23,053.60 acres.

Norway. T. 103 *N., R.* 8 *W.*

An irregular patch of prairie enters this town from the south and west, becomes narrow in the central portion, but expands to three miles in extent N. and S. in the northeastern. This prairie belt is on divide between the tributaries of the South Branch and of Root river and is broken into by the bluffs that accompany those tributaries and extend beyond the limit of flowing water. Variation 6° 46′ to 9° 10′ Acreage, 23,012.08.

Rushford. T. 104 *N., R.* 8 *W.*

The only prairie land found in this town is that along the bottom land of Root river lying within the rock bluffs. This is marshy, except along the tributary valleys. Root river crosses the central part of the town, and flows several hundred feet lower than the level of the adjoining country. Magnetic Variation 5° 45′ to 9° 6′ Acreage 23,149.13.

Canton. T. 101 *N, R.* 9 *W.*

This township is wooded, except in the northeastern and south

eastern portions, and a small area entering from the west covering secs. 18 and 19. Mag. Var. 7° 5′ to 10° 56′. Acreage, 23,054.32.

Amherst. *T.* 102 *N.*, *R.* 9 *W.*

The larger portion of this town is prairie, broken with patches of thicket and heavier timber. Mag. Var. 7° 42′ to 10° 50′. Acreage, 23,045.72.

Holt. *T.* 103 *N.*, *R.* 9 *W.*

A prairie tract covers secs. 25, 35 and 36, and a portion of 31. With this exception, and the wet prairie within the river bluffs, this town is wooded. The Root river passes through sections 7, 8, 9, 3 and 2. Mag. Var. 5° 12′ (N. side of sec. 3) to 14° 51′ (N. side of sec. 5). Acreage, 23,046.70.

Arendahl. *T.* 104 *N.*, *R.* 9 *W.*

The prairie portion is in the northwest and centre. A belt of timber skirts along the northern boundary, and on the east unites with the timber of the Root river valley in the southeast. About one-half of the town is timbered. Mag. Var. 5° 21′ to 17°. (The former is on the south side of sec. 33, and the latter on the southwest part of the same section.) Acreage, 23,007.34.

Harmony. *T.* 101 *N.*, *R.* 10 *W.*

This town is represented as all wooded except about one section, covering parts of 14, 13, 23 and 24; and about half a section covering contiguous portions of secs. 18 and 19. (There seems to be an error in the plat of this town. The central portion is probably prairie.) Mag. Var. 9° 25′ to 12°. Acreage, 23,013.72.

Preston. *T.* 102 *N.*, *R.* 10 *W.*

This town is greatly diversified with frequent changes from prairie to thicket and timber. The Root river, which enters it in section 6, soon leaves it on section 5, but by its deeply eroded valley has brought in a marked diversity of surface, accompanied by more or less timber. Mag. Var. 9° 17′ to 12° 12′. Acreage, 23,008.29.

Carrollton. *T.* 103 *N.*, *R.* 10 *W.*

There is but little prairie in this town. The only parts so represented being in sections 35 and 36, and the northern portion of section 6. A tract of heavy timber occurs in the northwest, sections 7 and 8. The valley of the Root River, though very rough, is not always wooded. Mag. Var. 6° 12′ to 13° 45′. Acreage, 23,026.34.

Pilot Mound. *T.* 104 *N.*, *R.* 10 *W.*

In the northeastern part there is a prairie tract and also in t[illegible] northwestern, but the greater portion is represented as wooded, [illegible] covered with brush and thickets. The Root river, which crosses [illegible] in a southeasterly direction, brings in a deep valley of erosion, wi[illegible] rock-bound bluffs several hundred feet high. Var. 8° 51′ to 13° 45′ Acreage, 22,998.57.

Bristol. *T.* 101 *N.*, *R.* 11 *W.*

This town consists of prairie and thickets, a belt of the former widening to 5 miles toward the west, crossing it from east to west. Mag. Var. 10° 20′ to 12° 40′. Acreage, 23,026.98.

Carimona. *T.* 102 *N.*, *R.* 11 *W.*

There is an area of prairie in the southwestern corner of this town, but the most of the town is covered with sparse timber, with patches of heavy timber. It has a great many "sink holes." Mag. Var. 8° 30′ to 12° 15′. Acreage, 23,071.37.

Fountain. *T.* 103 *N.*, *R.* 11 *W.*

A great many "sink holes" also are found in this town. It has small patches of timber or oak thickets, scatterred over the whole area, and a considerable heavy timber along the streams. Watson's creek crossing it from west to east, is the cause of a considerable diversity of surface. Var. 8° 5′ to 11° 6′. Acreage, 23,103.77.

Chatfield. *T.* 104 *N.*, *R.* 11 *W.*

The North Branch of Root river, with its various tributaries, causes a rough and sometimes rocky character of surface to prevail in much of this town. It has but little real prairie, though there are openings in the thickets and oak bushes that are without timber. Mag. Var. 7° 51′ to 11° 2′. Acreage, 23,022.63.

York. *T.* 101 *N.*, *R.* 12 *W.*

A tract of wood and thicket crosses this town N. and S., about two miles wide, east of the center. The rest is prairie. Mag. Var. 9° 49′ to 11° 43′. Acreage, 23,076.54.

Forestville. *T.* 102 *N.*, *R.* 12 *W.*

The central part of this town is covered with timber and small oaks and aspens. It has a tract of prairie in the N. W. and in the S., both together covering about six sections. It abounds in sink holes. Mag. Var. 9° 41′ to 12° 2′. Acreage, 23,205.28.

Fillmore. *T.* 103 *N.*, *R.* 12 *W.*

There is a region of heavy timber west of the Middle Branch of Root river, in this town. The rest is prairie interspersed with thickets and patches of oak brush and aspen. Mag. Var. 8° 40′ to 11° 42′. Acreage, 23,032.33.

Jordan. *T.* 104 *N.*, *R.* 12 *W.*

The greater portion of this town is covered with heavy timber, the only noteworthy region of prairie being in the northwestern corner, covering secs. 6, 7 and 18, and parts of 19, 20, 17, 8 and 5. Mag. Var. 9° 42′ to 12°. Acreage, 23,035.51.

Beaver. *T.* 101 *N.*, *R.* 13 *W.*

A strip of timber accompanies the valley of Slough Creek, across the whole of this town, from section 6 to section 35, and the rest is of prairie, with several narrow sloughs, running generally north and south. Mag. Var. 8° 59′ to 11° 15′. Acreage, 23,072.50.

Bloomfield. *T.* 102 *N.*, *R.* 13 *W.*

There is an irregular area of timber and oak brush in the eastern and central part of this town, accompanying and spreading northward from the valley of the South Branch of Root river, but about two-thirds of the whole is of prairie, with a few sloughs in the eastern part. Mag. Var. 9° 8′ to 12°. Acreage, 23,013.96.

Spring Valley. *T.* 103 *N.*, *R.* 13 *W.*

There is a belt of prairie covering the southern tier of sections, including parts of 29, 28 and 27. The rest is sparsely or heavily timbered. Var. 10° 15′ to 13°. Acreage, 23,063.86.

Sumner. *T.* 104 *N.*, *R.* 13 *W.*

The southeastern part of this town is wooded, but more than one-half is of prairie, and flat. Mag. Var. 8° 25′ to 13° 15′. Acreage, 22,915.69.

Soil and Timber.

The soil of the county is generally very fertile. The immediate surface is a loam. This varies in color and composition, as well as in origin. That portion of the county covered with the northern drift has primarily a drift soil, which consists of gravelly clay. Where this forms the immediate surface, which is the case only on knolls and on the brows of the river bluffs, it affords a soil of an ashen color, if dry. In timbered belts it is more stony, or gravelly. In the open prairies, and in low grounds, it is covered with a loam.

This is believed to have resulted from the natural decomposition of the coarse materials of the drift, under the calcining influence of the prairie fires, and the frosts of ages. It has never been seen stratified, or arranged with any regularity that would indicate its having been deposited either by standing or running water. In most cases, especially on the open prairie, it is nearly black. As it is mingled with the drift clay, it becomes lighter colored. In the low grounds it is much thicker, and also of a black color. Overlapping the drift area, in a belt about five miles wide, is a soil formed by the mingling of the loess loam with the drift. The loess loam is later than the glacial drift, and in the process of deposition it is modified by contact with the drift clay. The loess loam is indistinctly stratified, though it usually appears massive, and consists of fine, often clayey, sediment. The soil derived from it, usually sandy and light colored, or rusty, is sometimes so clayey as to make, when wet, a fine and very slippery mud. The soil derived distinctively from the loess loam covers at least one-half of the county, and is supposed to extend to the Mississippi river. It makes a rich and apparently a strong soil, as it supports a cropping of wheat from year to year. It is impossible to define its western limit. If it were derived from a long-standing inland lake, some beach lines would be found indicating its western boundary. No beach lines have been found. That it was deposited from standing water can hardly be questioned. It thins out westwardly gradually, passing through a confused or mixed condition, resulting from the mingling of the drift materials with the sediment, or by its overlapping the drift. While the essentially loess loam soil, of the eastern part of the county, can be distinguished easily from the drift soil of the western, no line of demarkation separating them has been noticed. A line drawn from the southeast corner of Bristol to the northeast corner of Jordan would roughly set off the area that has a distinctively loess loam soil. West of that is a belt five or six miles wide, in which the loess loam soil mingles with the drift soil. The rest of the county toward the west is occupied with a distinctively drift soil, or drift loam soil.

The following list embraces such native trees and shrubs as were seen in the survey of the county. The trees are arranged in the estimated order of frequency. The area covered by native timber is steadily increasing:

Burr Oak. Quercus macrocarpa. *Michx.*

Red Oak. Quercus rubra. *L.* (*?*) [This is the oak that is abundant underbrush, and small trees. It often forms thickets skirting the outli of a prairie.]

Aspen. Populus tremuloides. *Michx.* [Generally small, and on borders of prairies.]

White Oak. Quercus alba. *L.* [Common in the timber in Spring Va and Jordan townships, and generally along the valleys of the princ streams.]

Wild Plum. Prunus Americana. *Marsh.*

Great-toothed Poplar. Populus grandidentata. *Michx.* [Very freque mistaken for the American Aspen.]

American Elm. Ulmus Americana. (*Pl. Clayt.*) *Willd.*

Bass. Tilia Americana. *L.*

White Ash. Fraxinus Americana. *L.*
American Crab. Pyrus coronaria. *L.* [Common along the margins of prairies and in open valleys.]
Iron Wood. Ostrya Virginica. *Willd.*
Red Maple. Acer rubrum. *L.*
Sugar Maple. Acer saccharinum. *Wang.* [Common in the heavy timber in Spring Valley and Jordan township.]
Cottonwood. Populus monilifera. *Ait.*
Black Cherry. Prunus serotina. *Ehr.* [Trees generally small.]
Black Oak. Quercus tinctoria. *Bart.* (?) [Found in the heavy timber in the northwestern portion of the county.
Bitternut, Carya amara. *Nutt.*
Butternut. Juglans cinerea. *L.* [Seen most abundant in the heavy timber in the northwestern part of the county.]
Wild Red Cherry. Prunus Pennsylvanica *L.*
Thorn Apple. Crataegus coccinea. *L.*
Cockspur Thorn. Crataegus Crus-galli. *L.*
White Birch. Betula alba. Var. populifolia. *Spach.* (?) [Trees small; generally on stony soil, or along rocky river banks.]
Black Walnut. Juglans nigra. *L.* [In the heavy timber of the northwestern part of the county.]
Box Elder. Negundo aceroides. *Mœnch.*
Small Cedar. Juniperus Sabina, *L.* Var. procumbens, *Pursh.*(?) [Along the rocky river bluffs.]
White Pine. Pinus Strobus. *L.* An occasional large tree is seen along the river bluffs; but the most of it, suitable for lumber, has been cut.
Water Beech. Carpinus Americana. *Michx.*
Shag-bark Hickory. Carya alba. *Nutt.* [Seen in the valley of Root river, and in the tributary gorges at Rushford.]
Smooth Sumac. Rhus glabra. *L.*
Cornel. Cornus paniculata. *L'Her.*
Cornel. Cornus circinata. *L'Her.*
Wolfberry. Symphoricarpus occidentalis. *R. Br.*
American Woodbine. Lonicera grata. *Ait.*
Juneberry. Amelanchier Canadensis. *Torr. and Gray.*
Hazelnut. Corylus Americana. *Walt.*
High Blackberry. Rubus villosus. *Ait.*
Red Rasperry. Rubus strigosus. *Michx.*
Black Raspberry. Rubus occidentalis. *L.*
Dwarf Wild Rose. Rosa lucida. *Ehr.*
Pipe Vine. Aristolochia Sipho. *L'Her.* (?)
Grape. Vitis cordifolia. *Michx.*
Virginia Creeper. Ampelopsis quinquefolia. *Michx.*
Nine Bark. Spiraea opulifolia. *L.*
Sheep-berry. Viburnum Lentago, *L.*
Staghorn Sumac. Rhus typhina. *L.* (Rare.)
Bittersweet. Celastrus scandens. *L*
Rose. Rosa blanda. *Ait.*

The Geological Structure.

The rocks of the county belong to the Devonian and to the Upper and Lower Silurian ages. The Cretaceous also appears in Sumner township, in the extreme northwestern corner of the county. They occur as arranged in the following order, with their approximate thicknesses:

1. Cretaceous. Thickness unknown, perhaps 100 feet, lying unconformably on the older rocks.
2. Upper Devonian. Hamilton.
3. Lower Devonian. Corniferous.(?) } 100 feet.?

4.	Niagara of the Upper Silurian		200–250 feet.
5.	Maquoketa (Cincinnati) of the Lower Silurian		*75–100 feet.
6.	Galena, of the Lower Silurian		75–100 feet.
7.	Trenton, of the Lower Silurian		160 feet.
8.	St. Peter, of the Lower Silurian		122 feet.
9.	Shakopee,	Lower Magnesian of the Lower Silurian,	75 feet.
10.	Jordan,		25–40 feet.
11.	St. Lawrence,		200 feet.
12.	St. Croix, of the Lower Silurian, exposed		375 feet.

With the exception of the Cretaceous these formations have a *strike* across the county northwest and southeast. They have a gentle dip, at least theoretically, toward the southwest, though no general dip is perceptible. The oldest rock in the county is the St. Croix sandstone, which appears in the northeastern corner of the county. The latest, except the Cretaceous, is the Devonian, in the southwestern part of the county. The areas of outcrop are shown by the colored map of the county accompanying this report. The boundary between the Trenton and the St. Peter is the most accurately defined, owing to the terrace which marks it. The boundary between the St. Peter and Shakopee it is impossible to ascertain certainly, because of the universality of the loam, which acts, in that respect, just the same as a heavy drift deposit, and also because of the persistency of the Shakopee compared to that of the St. Peter. When the friable rock is below a hard and persistent one, as the St. Peter below the Trenton, the boundary between them can be traced out easily by the resulting topography; but when the soft one is uppermost it wedges out imperceptibly under the loam, or drift, and one cannot say when it is all gone. In the western part of the county the boundary lines are all obscured by the prevalence of the drift. The Maquoketa shales have not been seen in the county. They are visible in the bluffs of the Upper Iowa River, at Lime Springs, about three miles south of the State line, and very probably continue through Fillmore county, in the strike of the Lower Silurian.

The St. Croix Sandstone.

The area of the St. Croix sandstone is small. It only occupies the lower portion of the river bluffs, and the bottom land included between them, from the county line, near Rushford, to near Lanesboro. This bottom land is sometimes two miles, or more, in width, but it is an alluvial deposit, and never reveals the rock. The only visible outcrops are in the slopes of the bluffs. This sandstone also enters the county, in a similar manner, in the valley of the South Branch of Root river, and extends about three miles west of the county line.

Its *general lithological character* is all that can be learned of this rock from its exposures in Fillmore county. The opportunity for examination is very unfavorable. The bluffs, over the interval occupied by it, are almost universally turfed, and a heavy talus rises nearly or quite to the lower level of the St. Lawrence limestone. It

* Geology of Wisconsin, Vol. I, p. 181.

is in general a light colored sandstone, with alternations of limestone, and some shale, in its upper portions. The sandstone layers crumble easily. Some of the beds are of a very coarse grain, but the quartz is generally white, almost transparent. The limestone layers are like that of the St. Lawrence, and contain a few fossils, none of which have been studied yet with care sufficient for reliable specific identification. At Whalen, about 95 feet of the St. Croix sandstone are included in the lower slopes of the bluffs. This thickness of bedding disappears below the river level before reaching Lanesboro. At Rushford, the sandstone, and talus which is supposed to consist mainly of sandstone, rise 375 feet above the river. Near the upper portion of the sandstone, a conspicuous terrace or line of frequent exposure, producing a shoulder, may be seen along the creek in entering Rushford from the south.

The St. Lawrence Limestone.

This is the lowest portion of the *Lower Magnesian* formation of Dr. D. D. Owen. In the annual report for 1873, the geology of the Minnesota Valley is given. It is there announced that the great formation to which the name *Lower Magnesian* has been applied, consists of three distinct members—two limestones separated by a sandstone—and the names of the localities where these members have their characteristic outcrops, in that valley, were applied to distinguish them, as they will play an important part in working out the detailed geology of the eastern portion of the state. Since the publication of that report, a similar subdivision of the Lower Magnesian has been discovered in the state of Wisconsin, and it is announced in the American Journal of Science and Arts, for June, 1875, by Prof. R. Irving, of the University of Wisconsin. The county of Fillmore lies intermediate between the two points at which this similar alternation of parts in the Lower Magnesian has been identified, and may throw some light on the question of the parallelism of these principal members. Fillmore county is separated from the Mississippi river by one county, Houston, which is 24 miles in width, east and west, and borders on the state of Iowa.

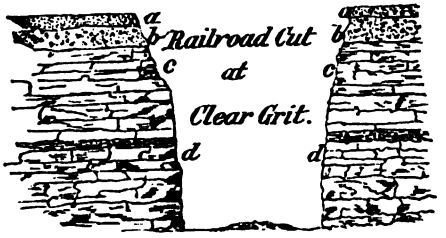
The *area* of this limestone is embraced in that which is, in general, assigned to the Lower Magnesian on the accompanying map. Along the river bluffs, nearly to Rushford, it is found only in the lower portion of the limestone belt, as the Jordan sandstone and Shakopee limestone are both preserved, and overlie it; but toward Rushford this limestone begins to be the only one that is found in the bluffs, the other members of the lower Magnesian having a strike across the country some miles in either direction away from the immediate valley. There are places, even further east still, where the overlying Jordan and Shakopee are preserved and appear in the tops of the river bluffs. The St. Lawrence extends in the bluffs of the Root river to some distance above Isinours' Station, and nearly to the lower mill at Preston. The valley of Watson's creek at Isinours' Station is cut about 25 feet into the St. Lawrence. At Lanesboro the amount of the St. Lawrence visible is about 195

feet. At Whalen 155 feet are seen in the upper portion of Whalen's bluff. At Rushford the uppermost 190 feet of the bluffs are of the St. Lawrence. The thickness of the formation is not far from 200 feet. It constitutes the principal portion of the Lower Magnesian.

The St. Lawrence, in Fillmore county, is a *dolomitic limestone*, with some of its layers distinctly arenaceous, and stained with green sand. In general, its bedding is regular and evident, but there is a thickness of about 15 feet near the bottom of the formation in which the bedding is confused, or the layers are lost horizontally. Below this confused bedding are, however, about 25 feet of regular beds, which have a fine even grain, and though not plainly arenaceous, yet have a very fine grit. On fresh surfaces it is of a buff color, varying to cream color. The upper portion abounds in patches of white calcite. There are also in the upper portion spots that show thin, concentric, though wavy, laminations, as if from concretionary forces, or the result of silicified masses of *foraminifers*, reminding the observer of the laminated masses of limestone from the *Laurentian* containing the *Eozoon Canadense* of Dr. Dawson. Though the most of the rock of this formation is vesicular, often coarsely so, it is much used for building, for which it furnishes both large blocks for the heaviest masonry, and fine-grained stone that can be cut into delicate forms. When cut for window caps or sills the cut surfaces are nearly white. The bedding varies in thickness from two or three inches to two or three feet, and sometimes embraces thin beds of shaly, light-colored, fine-grained rock that is useless for all purposes.

At Clear Grit Mills, in the valley of Root river, the St. Lawrence begins to show a continious line of bare rock, in the river bluffs running along the lower slopes, and causes a shoulder or terrace in the general descent. A quarry near the mill-dam shows about 15 feet of even layers. Above these are the layers represented in the railroad cut near that place. These are light-colored, dolomitic vesicular, abounding in patches of calcite with some chert, and siliceous concretions, the latter sometimes covered with limonite pseudomorphous after pyrite. The annexed profile exhibits the cut and the materials exposed.

Fig 2.



a.—Loess Loam, 8 feet, red.
b.—Drift Gravel, 4 feet, red.
c.—Jordan Sandstone, 16 feet, red.
d.—St. Lawrence Limestone, 30 feet.

At Whalen the St. Lawrence is finely exposed in the bluff that stands in the valley about half a mile below the village. It has here been considerably quarried, and furnishes a very good stone for buildings. It lies in even layers, which are easily broken into desirable size and shape, furnishing a good cut-stone of close grain, without openings. Of the 155 feet that here overlie the St. Croix sandstone, only the lower portion is well exposed. The exposed layers are separated from those seen at the quarry at Clear Grit by an interval of 50 feet. They consist of the following parts, aggregating 60 feet:

1. Slope, hid by turf, (St. Lawrence)..... 95 feet.
2. Heavy beds, even grained, vesicular, the best general building stone..... 20 feet.
3. Bedding confused, not evident, lenticular..... 15 feet.
4. Fine grit, regular beds, dolomitic..... 20 feet.
5. Hard arenaceous, projecting, fossiliferous with the remains of trilobites..... 5 feet.

At Lanesboro the St. Lawrence has been used in the construction of the principal buildings. The quarries are owned by the Lanesboro Company. The stone presents the usual characters, but has associated masses of pyrite, largely converted to limonite, showing octahedral forms of crystals, with combinations. In some of the cherty nodules, are found small orthorhombic crystals of hydrated iron peroxide, formed by the conversion of marcasite into limonite. This iron ore is quite plentiful, but seems not to be a native of the rock. It embraces crag and bog-ore deposits, and is referable to the drift period. (See under *drift*.)

The Jordan Sandstone.

This sandstone, lying next above the St. Lawrence limestone, is not so frequently seen along the river bluffs. It is most commonly embraced in that interval of slope that comes between the two lines of limestone outcrop, and which is mostly turfed over, as in the bluffs at Lanesboro, and at points between Preston and Lanesboro. Further down the river, where the strike of the Shakopee runs back from the river a few miles on either side of the valley, it occupies the undulating surface between the immediate river bluffs and the boundary of the Shakopee, as at Rushford. This sandstone, in the Minnesota valley, has been mistaken for the Potsdam, the overlying Shakopee being supposed to be the lower portion of the lower Magnesian. (*Owen's Geological Survey of Wisconsin, Iowa, and Minnesota*, pp. 481–495. See, also, Prof. James Hall's "*Notes on the Geology of some portions of Minnesota, from St. Paul to the Western part of the State*," 1865.)

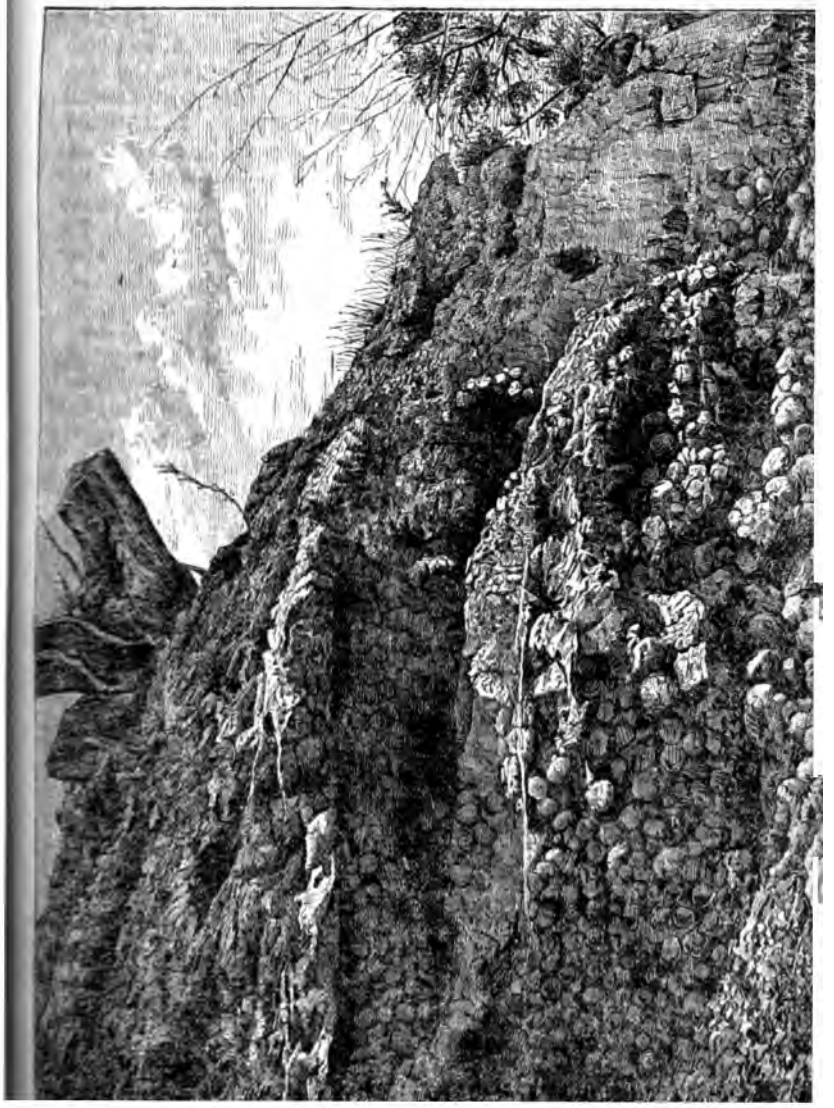
In Fillmore county the thickness of the Jordan is not so great as it is in the Minnesota valley. It seems to vary from 25 feet to 40 feet. At Mankato, in Blue Earth county, it is fully fifty feet thick. It is uniformly a coarse grained, quartzose, crumbling and light colored sandstone. It is sometimes locally stained with iron from

surface water, when it presents a reddish or rusty color, and is apt to be much harder. It has in such cases a shell or thin coating of harder rock, about half an inch in thickness, on the weathered surfaces, on penetrating which the grains are loosely cemented, and even crumbling. In other places, it presents internally a streaked appearance, due to the stoppage of iron filtering through its strata. No fossils have been found in it.

One of the best exposures for examining this sandstone may be seen at Preston, where it rises 25 feet above the level of the river opposite the stone mill, and is surmounted by about 35 feet of the Shakopee limestone. The bluff itself rises about 95 feet above the river, but the contents of the upper portion, though probably of the Shakopee, are not certainly known. The loam covers it. The bedding of the stone here is regular, though in some places a little wavy, and is of all thicknesses, from a foot to three or four inches.

At Lanesboro the Jordan exhibits, near the top, a finely concretionary structure. The balls vary from a few inches to nearly a foot in diameter. Some of them are elongated, and several are frequently united. The rock itself is generably friable, and crumbles out, leaving the concretionary shapes visible. They are often loosened, and roll down the bluff. They lie in approximate layers for a thickness of four or five feet. Some of them are pendant from the projecting shelf, and stud the whole under surface. They are generally spherical, but when they are lengthened perpendicularly, they show the original lamination that ran through the rock, in the form of rings and furrows. The accompanying view, engraved from a photograph by Andrew Ellickson, of Lanesboro, gives an imperfect representation of this portion of the bluff. This view was taken near the mill dam, above the railroad cut.

FIG. 3.



At Clear Grit the Jordan is 25 feet thick, and is exceedingly f ruginous. At Lanesboro it is about 40 feet thick.

The Shakopee Limestone.

This is the uppermost member of the Lower Magnesian, and is s named from the village of Shakopee, in Scott county, on the Mi nesota river, where it was first identified as a distinct and enti member of the great Lower Magnesian Formation. In Fillmor county it is more frequently seen along the valley of Root river an its tributaries than any other formation. As it lies between tw sandstones, each of which easily crumbles away under the operatio of the elements, it is made to have a prominent position in givi form to valleys and river bluffs. The North Branch of Root riv enters on it about six miles northwest of Chatfield, in Olmsted county the Middle Branch near the town line between Chatfield and Jordan, and the South Branch but a short distance below Forestville. South Root river strikes it near Henry, in Amherst township. Thus, throughout about two-thirds of the county, it is the constant companion of the traveler along the river valleys, and it meets him often in the uplands, and in the valleys of little creeks. Its effect on the topography is to render the valleys narrow, rocky and abrupt. Within the general area of the St. Peter sandstone and the Trenton limestone, it produces a shoulder in the descent from the uplands to the valley. The following diagram, taken at Chatfield on the northern boundary of the county, illustrates in general the effect of this limestone in producing a terrace along the lower slopes of the river bluffs, within the general Trenton area.

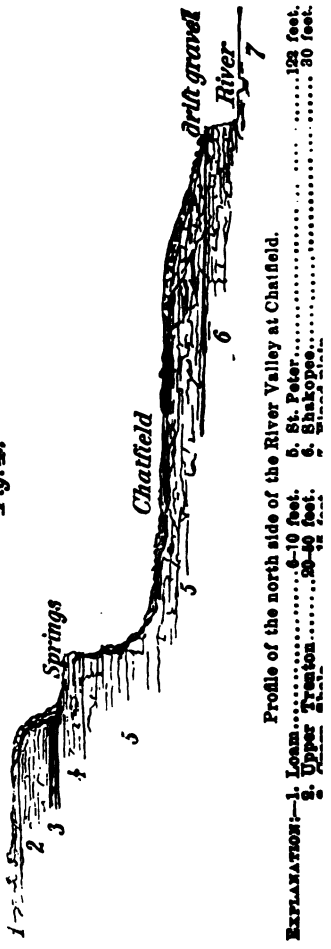


Fig. 4.

The descent from the general level of the country at Chatfield (No. 1) to the river (No. 7) is about 222 feet, of which about 30 feet are of the Shakopee, the descent from the Shakopee to the river being at the river. The broad terrace on which Chatfield stands is constituted of the Shakopee overlain by irregular thicknesses of the St. Peter, with some drift and

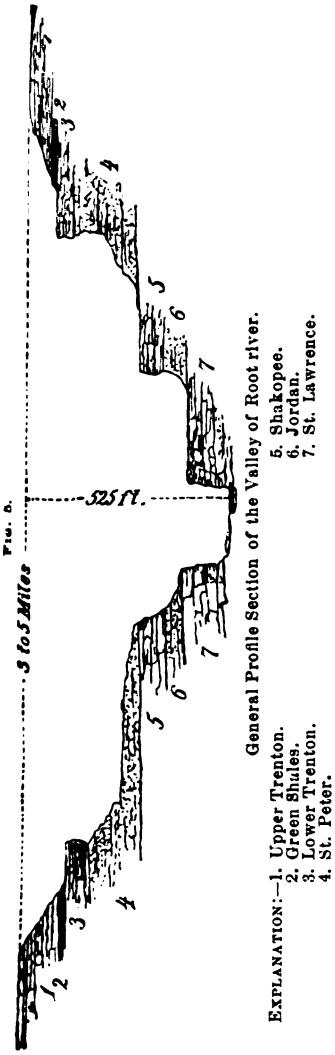


FIG. 8. General Profile Section of the Valley of Root river.

loam. The lithology of the Shakopee is very much the same in Fillmore county as it has been described in former reports at Mankato and Shakopee, in the Minnesota Valley. It is very similar to the St. Lawrence, with much less of green sand. It contains at Chatfield considerable disseminated sand, and nodules of calcite. The calcite is sometimes purely transparent, so as to exhibit the double refraction of Iceland spar, parting into large rhombohedrons, but the most of it is opaque. It is sometimes interspersed with sand grains taken up in the processof crystallization. These are so abundant as to make, of some crystalline masses, a sandstone which is then nodular and hard, with warty projections.

At Parsley's Ford, centre of sec. 15, Chatfield, a bridge is being built over the river. the abutments being of the Shakopee stone taken out near the ford, on Mrs. Doyle's land. At the ford the river is on the Jordan sandstone. There has been considerable stone cut off the bluffs, in the Shakopee, for use in the railroad bridge near the same place, and laid up in heavy blocks; but much of the Shakopee is in irregular and thin layers, unfit for such use.

At almost any point east of Chatfield and Carimona, the Shakopee can be seen by one crossing the valley of Root river, exhibiting its peculiar tendency to narrow the valley, and forming a conspicuous bench or shoulder. The following diagram of a general profile section of the valley, illustrates its form at points between Preston and Lanesboro; also between Chatfield and Lanesboro, along the North Branch. At Preston the rocks show a dip to the south.

At Isinours' Station the battlements of rock that enclose the valley, rising about 30 feet above the water, are of the Shakopee. There is an undulating ascent thence over the St. Peter to near the Trenton terrace, which rises nearly perpendicular about 50 feet. Beyond this is a flat, running sometimes but 8 or 10 rods, but not infrequently a quarter of a mile, when a further gradual ascent

begins, covering the Green Shales and the Upper Trenton. This last ascent, with the loam that here covers the country, generally makes about 175 feet.

At Carimona, the Shakopee is visible in the banks of the river, rising 25 or 30 feet. Its average thickness is about 75 feet.

The St. Peter Sandstone.

The thickness of this well-known formation in Fillmore county does not vary much from its reported thickness in the central portion of the state. It has been taken at 125 feet. At Chatfield it measures, by aneroid, 122 feet. In lithological characters it is also the same, consisting of clean white sand that easily crumbles. Near Fountain, an exposed section near the top of the formation afforded fragments of an unknown species of *Lingulepis*, the first and only fossil of any kind that has ever been found in this rock. The following section was taken at this place. It includes the overlying lower Trenton, and the green shales, as seen at the quarry of Mr. Joseph Taylor, section 13, Fountain.

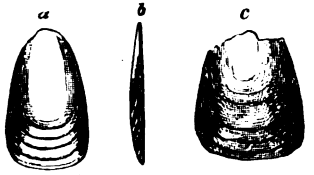
Section Near Fountain—Quarry of Joseph Taylor.

No. 1.	Green shale, mixed with fragments of limestone that are eminently fossiliferous..... seen	3 feet
No. 2.	Limestone, of a bluish-gray color, in beds from four to six inches thick, free from shale, though the layers are sometimes thinly separated by shaly partings.....	10 feet
No. 3.	Arenaceous and ferruginous shale, alternating horizontally with firmly cemented patches of sandstone.....	2 feet
No. 4.	Massive, coarse sand; white, except where iron stained, containing irony quartzite pebbles, and fragile remains of bivalves.....	6 feet
No. 5.	Green shale, with some arenaceous and calcareous laminations.....	3 feet
No. 6.	Cemented sandstone, the cement being shale and lime, forming when the bluff is weathered, the floor of a bench	1 foot
No. 7.	White sand, in beds that are about one foot thick, and horizontal.....	6 feet
No. 8.	A course in the sandstone more firmly cemented, forming another table, but less persistent than No. 6.....	1 foot
No. 8.	Massive sandstone, in some places showing an oblique lamination..... seen	6 feet

The Southern Minnesota railroad here enters on its descent to the Root river valley.

The species of *Lingulepis* mentioned is found in No. 4 of the foregoing section. The remains are exceedingly fragile, and as the grains of sand in which they are embraced are feebly cemented together, it is nearly impossible to transport, or even to handle them without their falling to pieces. These fragments, for no entire specimens were obtained, are arranged promiscuously in the coarse sand and are all confined within three feet of the top of No. 4. They seem to have suffered the attrition and friction incident to coarse sedimentary transportation. They dispel the idea, which has been suggested, of the possible chemical origin of the St. Peter sandstone, as an oceanic precipitate.

FIG. 6.



Lingulepis Morsensis. (N. sp.) Natural size.

Description.—Shell conical or elongate-conical, with anterior angles rounded; depressed; the apical angle not seen perfect; the front margin gently convex; sides nearly straight, but converging at an angle of about 26 degrees; greatest width is near the front and at a distance from the anterior margin of one-third the greatest width. The surface is smooth and shining, marked with very fine concentric striæ, visible especially in the anterior portion, and with more distant, dim undulations of growth. Entire length of the larger specimen seen (Fig. c.) about .85 inch; width .52 inch; length of the smaller (Fig. B.) .78 inch, width .45 inch. Color of the shell light brown, with spots of brown. The smaller specimen has flattened, or slightly concave margins, for nearly two-thirds the length from the apex. This species in general contour resembles *Lingulepis Briseis*, of Billings, (Palæozoic Fossils, Vol. 1, p. 48,) but differs from it in not having its sides parallel.

Locality and Formation—Near Fountain, Fillmore county. Upper portion of the St. Peter sandstone. Named in honor of Prof. E. S. Morse.

The remarks that have already been made on the topography of the county, and the diagrams that have been given, will sufficiently elucidate the nature of the St. Peter, and its important part in the causes that have diversified the surface of Fillmore county.

The Trenton Limestone.

This formation is the most important one of the county, both on account of the great superficial area it embraces, and because it appears in numerous places under the most favorable circumstances for working for quicklime and for building stone. It is likewise the most conspicuous of all the formations, especially along the line of its strike, where it gives way, and the surface falls rather suddenly on to the lower level of the St. Peter sandstone.

The term *Trenton limestone* is here made to cover a thickness of rock of about 160 feet, and to embrace, within the limits of Fillmore county at least, three distinct members, of which the uppermost is the principal portion.

Upper Trenton limestone	125 feet.
Green shale	15 feet.
Lower Trenton limestone	20 feet.

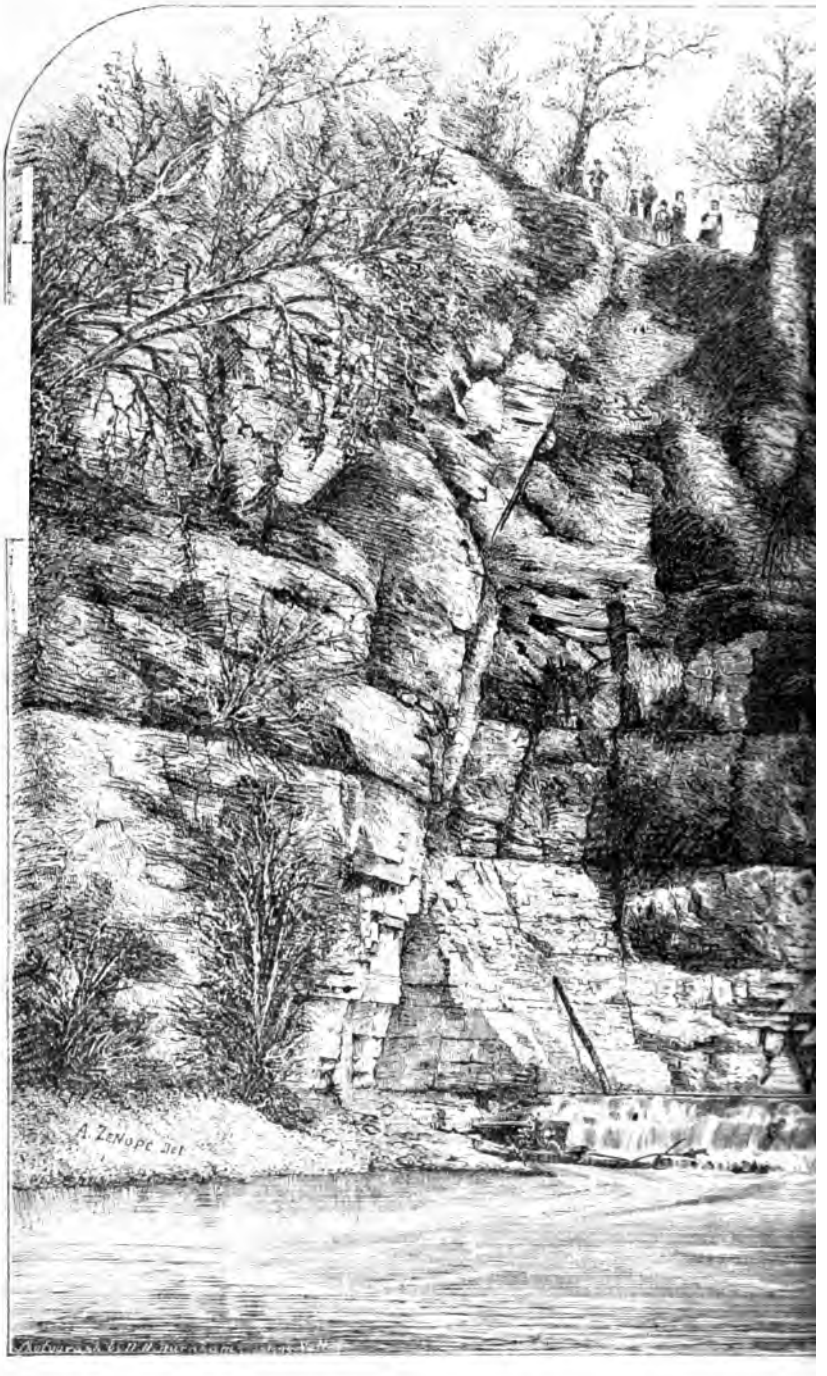
The transition from the St. Peter sandstone to the lower Trenton

is quite abrupt. There is no commingling of qualities from the Trenton downward into the St. Peter, although a shaly layer of about two feet separates them. The limestone always projects boldly beyond the sandstone, and the sandstone becomes immediately white and friable, with a very slight calcareous cement. The lower Trenton plays the most important part in producing the marked topographical characters of the central portions of Fillmore county, since, by its superposition over the crumbling St. Peter, it constitutes the edge of the shoulder or terrace that marks their line of superposition, and not unfrequently spreads out on the top of an isolated table or mound, thinly overlain by the lower layers of the green shale. Under the head of *Surface Features*, this point has been mentioned already, and the reader is referred to that section.

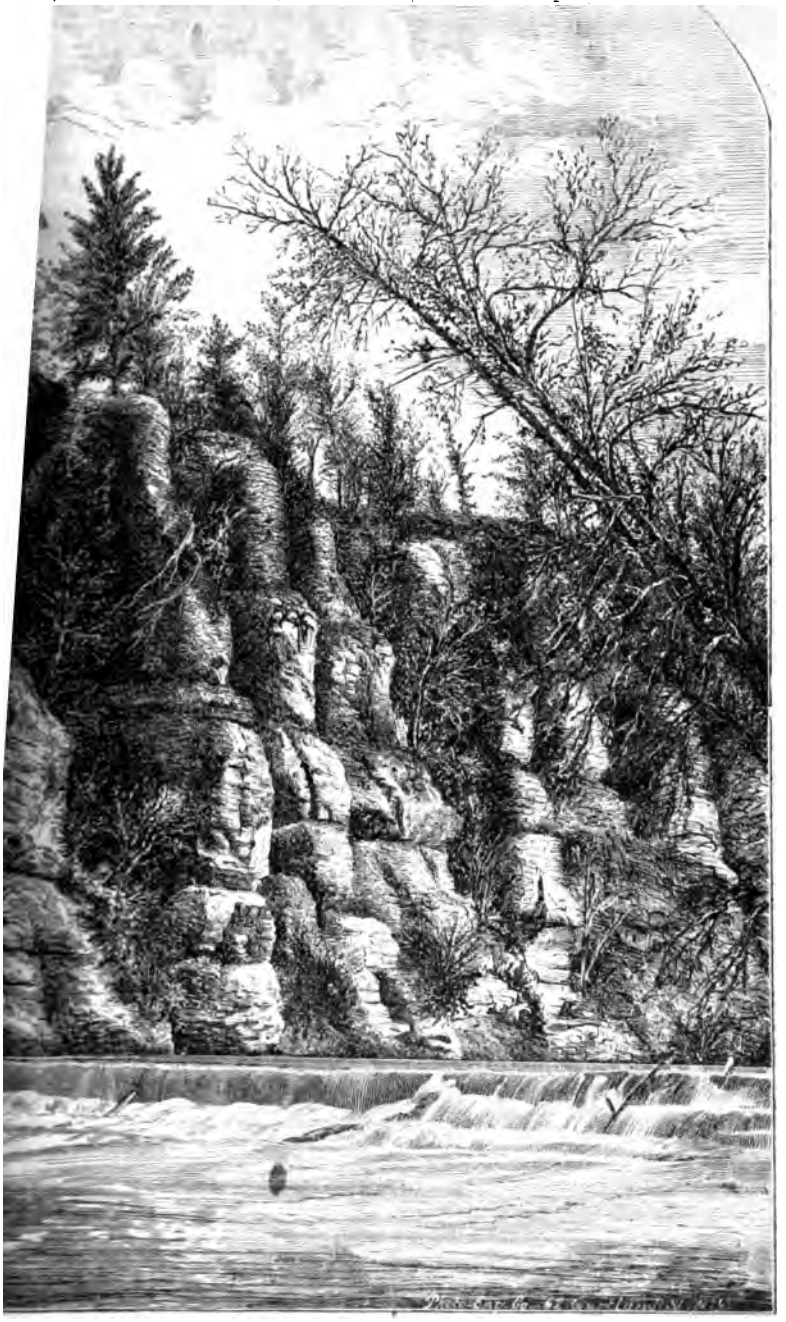
In Fillmore county, the lower Trenton, known sometimes as the "Buff limestone," which corresponds in horizontality with the limestone quarried at St. Paul and Minneapolis, is much less affected by disseminated shale than in those cities, and hence makes a much more desirable building stone. The color is light blue, and in quarrying the layers rarely exceed five inches in thickness. On weathered bluffs, the bedding appears even thinner than that, being apparently not more than two inches. When these layers are opened and considerably quarried they combine, and produce layers that are from four to six inches in thickness. They are generally tough and hard, though when broken they often fracture conchoidally, and in unexpected directions. The fossils they hold are undergoing careful examination. The most striking are species of *Orthoceras*, often regarded by the quarrymen as the remains of huge snakes, though really oceanic shell-fishes, and a beautiful species of *Lingulepis*.

The interval covered by the *green shale* (15 feet) is not often seen well exposed. The uppermost layers have not been seen at all in Fillmore county, but the lower layers are visible in many places where the lower Trenton is quarried. When wet constantly this shale becomes a plastic clay. Along the brow of the Trenton terrace it colors the earth in nearly all roadways that cross it, and produces, by shedding the surface water, very muddy spots, in which teams are sometimes mired. One remarkable spot of this kind is near the top of the bluff a mile and a half west from Chatfield, S. W. ¼ sec. 1, Jordan. This shale always lies in thin layers, and sometimes embraces continuous beds of blue limestone which are exceedingly fossiliferous. It also sometimes holds fragments of limestone, of the same kind, in the form of slabs. A great many fragments of *Chaetetes Lycoperdon* accompany this shale and roll down the face of the weathered slope, besides crinoidal fragments and species of *Orthis*, *Leptaena* and *Strophomena*.

The Upper Trenton, sometimes known as the Blue limestone in the northwest, which is about 125 feet thick, consists of a bluish or grayish, evenly bedded limerock, varying from fine-grained and compact, in layers of a few inches, to more vesicular, sometimes arenaceous, and in beds of one to two feet. It contains but little



VIEW OF THE UPPER TRENTON AT



M. SEC. 11, SPRING VALLEY.

shale in Fillmore county—and that is near the base and near the top. This rock forms a great many precipitous bluffs. It appears in the form of mural faces along a great many creeks and canons in the central portion of the county. It generally rises nearly perpendicularly from the top of a short talus to the summit, exhibiting a continuous section of the bedding. Its area is pre-eminently the region of sink holes. The canons that are so frequent in it run out in ascending the valleys, and disappear in a succession of sink holes which become smaller and smaller, and more and more distant, till the general praire level is reached. While in general the lithological characters of this part of the Trenton are quite uniform, near the top the layers begin to alternate with layers that exhibit the characteristic lithology of the Galena, and are accompanied with some thin layers of green shale. It seems to pass gradually into the Galena, or rather to assume the features that have been ascribed to that formation.

The following views represent the manner of weathering of the Upper Trenton. At Weisbeck's Dam, on Deer Creek, S. E. ¼ sec. 11, Spring Valley, the face of the bluff, which rises perpendicularly about a hundred feet, is wrought into a series of majestic pilasters running from the bottom to the top of the escarpment. The view here given is from a photograph by D. D. Burnham, of Spring Valley, engraved by the *Photo. Engraving Company*, 62 Courtlandt Street, New York.



Figure 9, Chimney Rock, is a view on the side of the bluff of a ravine, tributary to the south branch of Root River, on section 27, Forestville. A crevice, originally due probably to a plane of jointage, enters the rock at a small angle with the face of the bluff, and has been widened by frost and water till it will admit a man. The detached, wedge-shaped mass, has been broken through near the foot of the bluff, and by the falling out of repeated fragments an opening having a fancied resemblance to an oven with a low chimney, has resulted.

FIG. 9.



Chimney Rock—Trenton Limestone, Section 27, Forestville.

The following details concerning the Trenton limestone will further elucidate this formation as it appears at various places in the county.

Southeast quarter section 23, Spring Valley, quarry of John Kleckler. The rock here is a gray limestone, with interlaminations of shale. This is very different from the Galena, as seen at Spring Valley village. It is compact, and, with the exception of the thin laminae of shale, consists entirely of limestone. Exposed about 10 feet.

Southeast quarter section 23, Spring Valley, Joseph Lester has a quarry in the valley of the Middle Branch, very similar to Kleckler's. That of Henry Prosser occurs on southeast quarter of section fourteen.

North part of section 25, Spring Valley. At Mr. H. Perkins' saw-mill the same rock is visible, and has been wrought. From this point the banks of this creek become continuously rocky.

G. W. Knight's quarry is near Fillmore, section 10. The stone is hard, gray, compact, brittle and fossiliferous, in beds of all thicknesses, depending on the weathering and exposure, up to eight or more inches. It is situated along the ravine, approaching Fillmore.

Geo. Shepherd's quarry is also near Fillmore, on northeast quarter of section 9, and seems to consist mostly of isolated even layers in the shale that so frequently accompanies the Trenton. In this shale are *Chaetetes*, *Rhynchonella*, and *Strophomena*. The stone is not of much account, owing to its being encumbered so heavily with the shale, but is very desirable for the uniformity of its thickness. S. C. Pettit has a quarry of the same kind on northeast quarter of section 10.

At Chatfield, the lower Trenton appears in the highest bluffs on the north side of the village. It is made up very largely of shale, but affords also some even layers, that are wrought. These have the same stratigraphical horizon as the stone at Minneapolis and St. Paul, but do not contain so much argillaceous matter. They are much firmer and more compact, though not so thick in the aggregate. Below these layers the St. Peter sandstone is seen. The Trenton at this point has a gentle dip northeast, while the Shakopee at the mill by the river dips northwest. The brachiopod *Leptaena deltoidea*, so common at the Falls of St. Anthony, is here seen in great numbers, and an occasional specimen of *Lingula quadrata*. The section at the quarry of Dennis Jacob is made up of seven feet of limestone and shale, crumbling away, underlain by about eight feet of limestone.

Extensive working and burning of the upper Trenton into quicklime is carried on along Bear and Deer creeks, the banks of which are continuously rocky, rising perpendicularly from one to two hundred feet from the water, in Sumner and Spring Valley townships. These quarries are described under the head of *Economical Geology*.

Sometimes the Trenton shows, on freshly opened quarries, along the bluffs, almost a white color. This is particularly the case on north half of section 35, Sumner, where an opening in a long-weathered "hog's back" reveals a very light-colored limestone, in beds of about three inches, of a fine grain and compact texture; not

much crystalline, and evidently impure with argillaceous and siliceous qualities.

The quarry of Mr. Joseph Taylor, section 13, Fountain, has been mentioned already under the head of the St. Peter sandstone, and the exposed section given. At this quarry very large cephalopods have been taken out, and some fragments of galena have been encountered, though the opening is in the lower Trenton.

The quarry of Mr. Enoch Winslow is on the same horizon as Mr. Taylor's. It is situated on the bank of Sugar Creek, S. W. ¼ sec. 4, Fountain. Another on the same horizon is that of John Johnson, 2 miles south of Fountain. The Trenton is also wrought at Forestville and near Carmiona, presenting no exceptional features. At Forestville it contains *Receptaculites* and *Strophomena*, and exposes a thickness of about 140 feet.

The Upper Trenton appears S. E. ¼ sec. 6, Forestville, along a little ravine, and is slightly opened by John Hipes. It also appears at other points between there and Spring Valley.

At Baldwins' Dam, sec. 21, Forestville, 130 feet of the Trenton are seen. No Galena visible, and no Green Shale.

S. E. ¼ sec. 30, Forestville. In some fragments thrown out in the digging of a well, can be seen a fine grained rock, resembling the fine shale seen in the race at De For's mill, which crumbles to pieces in the weather. It here lies below some heavy Galena beds, seen in the hills enclosing the valley, and contains doubtfully species of *Graptolites*, *Orthis*, and *Orthonota*.

At Granger, the Trenton only occupies the bluffs; but at two miles west of Granger, where the river enters the state for a short distance, the bluffs are high, and are made up of the Trenton, with a topping of fifteen or twenty feet of Galena.

Northwest quarter of section 36, Bristol. Hiram Andrews has a quarry in the Trenton, which alone occupies, at this place, the river banks, though the beds of the quarry are apparently in the upper portion of the formation. The layers are thicker than usual, somewhat vesicular, and present some of the aspects of the Galena. The rock shows a slight dip to the south. Mr. Andrews has built a stone barn and stable.

The Galena Limestone.

The only separating horizon between the Trenton and Galena limestones is a lithological change in the rock. There is no unconformability between the layers of the formations, and there is no known difference of fossil contents. Near the upper portion of the Trenton occasional layers appear that are much more porous, and have a light buff color. They are also much heavier than the layers of the Trenton, reaching, after the change is fully established, a thickness of four or five feet. Mingled with these heavy magnesian layers are thinner layers of green shale. When these heavy magnesian beds are near the top of a bluff, they give it a roughness, but at the same time a persistence of outline which the thinner beds of the Trenton alone do not possess. This rock is generally sharp-

ly crystalline. It contains numerous cavities of irregular shap some due to the weathering out of carious material, and some to t absorption of fossils It holds considerable masses of calcite, a sometimes lumps of galena, from which it has derived its name. A though the Galena limestone, near Dubuque, in Iowa, is stated Prof. J. D. Whitney to be about 250 feet, (Geology of Wisconsi vol. I, 172,) it enters Minnesota with a thickness much le than that. From all that can be seen of it in Fillmore county, appears to be less than 100 feet thick. The Trenton, on the oth hand, is given, by the same authority, at 70 feet average thickne at Dubuque, while it has a thickness of 160 feet in Fillmore count

The characters that distinguish the Galena are not constant. Fillmore county the "lead fossil," *Receptaculites*, pervades t Trenton as low as the green shale, at least—although regarded characteristic of the Galena; and the *Lingula quadrata*, also said Prof. Whitney to not appear in the lead region, in the "blue" n the "buff," is found throughout both. A very fine specimen w obtained, of the latter, at Mr. Taylor's quarry, near Fountain, fro the lower Trenton, ("buff limestone" of Prof. Whitney,) and anoth from Chatfield, from the same horizon. Lithologically also the tw formations appear to merge into one another. The compact, ha blue limestone, characteristic of the Trenton, gives place near t top of that formation, to a lighter colored, slightly vesicular, ev grained, more heavily bedded rock, that is very useful for an orn mental cut-stone. This is seen in some of the quarries a mile two east of Spring Valley, where it is difficult to assign the beds e ther to the Galena or to the Trenton. A short distance further ea the well characterized Trenton appears, while at the village Spring Valley, unmistakable Galena features pervade the rock e posed, to the depth of ten or twenty feet. The lead ore, moreove which has given name to the Galena, is not confined to that form tion. It is found to some extent both in the Galena and the Tre ton, though in neither to that extent that will warrant sangui expectations.

The Galena, where not hid by the Cretaceous in the northweste part of the county, is within the drift area. Hence it has not be so fully observed as is desirable. The line separating its superfici area from that of the Trenton is defined with tolerable accuracy c the map accompanying this report, but the line of its western boun ary is very uncertain.

The principal exposures of the Galena in the county are on Be and Deer creeks, and at Spring Valley on the Middle Branch Root river. At the latter place quarries are worked to a greater less extent by Mr. Willard Allen, Thomas Thayer, Emylas Parson and Nelson Smith. These openings are on the south side of t valley and are all in about the same kind of stone. Some of the furnish, as yet, only rough large pieces, water worn and rusty, di lodged from their original places. The rock has undergone lon weathering and erosion at Spring Valley, and is disintegrated a changed to a considerable depth. Along the road near the publi school, a small cut in the shattered crumbling layers has exposed

great number of detached casts of a brachiopod resembling that of *Atrypa reticularis*. These were regarded with great curiosity by many as "little turtles" petrified. At J. Shumaker's quarry, one mile east of the village, about eight feet of the bedding are exposed. The layers here are of a finer and more uniform texture, and are associated with shale. When cut for building they are much whiter than the stone obtained at Mr. Allen's at Spring Valley. In considerable quantities of Galena are obtained at Spring Valley. No systematic exploration, however, has been undertaken, the pieces found being at or near the surface. It has been found at a number of other points in the county, sometimes well within the Trenton area.

N. W. ¼ sec. 16, Jordan. In ascending the south bluff of Lost creek, large loose pieces of Galena limestone are seen in the road, but the Trenton is in outcrop at the creek. Similar pieces appear on sec. 31, Jordan. These are on the most eastern limits of the Galena area, and belong to the lowest layers of the formation.

There is a weathered exposure of the Galena on land owned by Mr. —— Harris, northwest quarter section 26, Sumner. This outcrop fairly presents the typical lithological features that characterize the formation. By the Galena characters are meant a yellowish, or buff, limestone, vesicular, crystalline, in heavy layers, even on weathered bluffs, having usually a very rough exterior, in consequence of atmospheric destruction of the looser portions. When these looser portions are removed, the surface of the rock presents a pitted aspect, being covered with thimble holes, and depressions of all shapes, with angular knobs and excrescences separating them, the whole overgrown with lichens. The exposure here shows perpendicularly about twelve feet, in layers from one to four feet thick, piled up on either side of the road in detached mounds, like bridge abutments, from which the roadway has been removed. The "lead fossil," *Receptaculites*, appears in these layers.

At the crossing of the South Branch of Root River, northeast quarter section 21, Bloomfield, there is no cut in the rock visible. The river is but about twenty feet below the level of the country, which is in a broad, shallow valley; but in the road are a few pieces of Galena, showing fossils and lithology like the rock at Spring Valley, though the layers must be near the top of that formation. The country here, and toward the southwest, is a broad level prairie, gently rising toward the west.

Northwest quarter section 26, Bloomfield. The south bank of the river, near the west side of the section, has a rock bluff exposed about twenty feet above the river. This is massive, or in heavy layers, and is doubtfully assigned to the Galena, as it has some of the features of the Niagara. It is firm, but porous; of a buff color and a coarse magnesian grain, with superficial cavities, due to the weathering out of fossils. It is on the land of Mrs. Annie Postle. The crossing of the survey of the Winona, Green Bay and Grenelle railroad is at the head of the bluff. A similarly doubtful exposure, slightly quarried, is owned by Dora Wright, near the center of section 14, Bloomfield, by the roadside. Wm.

B. McVee has has also taken out the same stone near his barn, northwest quarter section 14, and used it in his barn foundation. It here holds considerable calcite.

At Etna Mr. S. S. Belding has a quarry in the Galena. This is a soft, porous stone, in heavy beds, which once held fossils, but which have been lost by absorption, leaving the rock porous, and finely vesicular, Mr. Belding states that this limestone has a hydraulic quality, but as near as can be ascertained it makes simply a quick-lime, which endures well under repeated wetting. An old foundation at De For's Mill was laid with it nineteen years ago and stands firm yet, though submerged by every freshet. It has not yet been subjected to the test of setting *under water*, which is the essential property of water lime. The rock here seen amounts to eighteen or twenty feet. Other quarries, similar to Mr. Belding's, are owned by O. M. Postle, northwest quarter section 36 Bloomfield, by Geo. Hoy and Mr. De For, northeast quarter section 25, and by H. T. Odell, southeast quarter section 36.

At De For's Mill, N. E. ¼ sec. 25, Bloomfield, the rock exposed is fine and even-grained, belonging probably to the lower portion of the Galena. It embraces one thin layer of a shaly limestone which has turned white. It makes a good quick lime. It is in heavy beds of about eighteen inches, and holds a coarse coralline form seen also at the quarry of Mrs. Postle, already mentioned. Below these heavy layers is a bed of shale which was exposed in the digging of the mill-race, having a thickness of five and a half feet. Below that thickness the shale becomes arenaceous, and in the weather crumbles to pieces. Among the crumbled fragments are indistinct remains of the buckler of a small trilobite.

At Foreston, one mile south of the state line, the Galena appears in the lower river bluffs, and is in very rough and heavy beds. It presents numberless cavities of all shapes, as large as a thimble and larger, and often iron-stained. It here has a noticeable dip to the south. While it is fossiliferous it is so coarsely and so completely crystalline that the fossils are either entirely absorbed or remain as indistinct impressions or imperfect casts. It contains white calcite in some large masses. The river itself at Foreston is probably on the Trenton, the water-power there improved being due to a change from the firm Galena layers to a softer shale, indicating the upper portion of the Trenton. On the state line, due north from Foreston a limestone appears in the road, of a coarsely crystalline grain, with calcite and cavities, entirely like the Galena. It is observable in a number of the hill tops, and extends half a mile at least, north of the state line. At a point about a mile north of the state line north from Foreston, and a fourth of a mile east (N. E. ¼ sec. 3, York) the upper Trenton appears on the N. E. side of a ravine while the Galena appears on the S. W. side, the road running between the two. The rock has a perceptible dip toward the south. The Galena occupies the high river-bluffs from that point nearly to Granger, on the north side of the river, when it passes to the south and the Trenton takes its place, both having a dip toward the south. At a point two miles west of Granger the Galena is 15 or 20 fe

thick in the top of the river bluffs, the Trenton underlying. These thick beds give a squareness and prominence to the tops of the bluffs, presenting a perpendicular rock-wall toward the river. Large masses of this rock fall from the bluffs and weather into the usual rough forms. Though this exposure embraces rock that is a little softer than the Galena at Foreston, yet in color, crystallization and all general characters it is the same.

The Maquoketa Shales.

This is the name given to the *Cincinnati Group* of shales and limestones, as they appear in Iowa, by Dr. C. M. White, of the Iowa survey of 1870. Without questioning the correctness of his conclusion that where these shales appear in Iowa they embrace a distinct portion, only, of that series known as the Cincinnati Group, his designation is provisionally adopted in our nomenclature. While it is certain that this formation enters the State from Iowa, being seen two miles south of the state line, at Lime Springs, it is still true, that not a single observation has yet been made on it within the limits of the State of Minnesota. Being made up of soft materials its outcrops are to be sought in the low levels, along the bottoms of ravines. As its area in Fillmore county is covered by the northern drift, it will probably be a long time before any well authenticated localities of its existence are known.

The Niagara Limestone.

This formation has been identified in Fillmore county, at but one point. It is much more enduring than the shales underlying it, but it enters on a drift-covered area, with small valleys of drainage only, some distance south of the state line. The nearest important point of its known outcrop is at Lime Springs, in Iowa. It differs from the Galena limestone in being much lighter colored, especially when broken or powdered. It is strongly crystalline, and often porous, but it is also, in some parts, a very firm and enduring limestone. It also has a very different and much more abundant fossil fauna. It is separated from the Maquoketa shales, at Lime Springs, by a limestone breccia of about 18 inches. Its color, in its heavier and close-textured portions, is somewhat grayish, or leaden, and it is interbedded with hard shale, which turns nearly white on exposure. This shale, in broken pieces, makes up the larger part of the breccia mentioned, and falls down the bluff in that condition, where it is lost in the weather, the framework of the cement only remaining, making a curious, open network or mesh, the partitions and threads enclosing angular apartments. The great bed of shale, which causes the water power here, may have a thickness of 75 or 80 feet exposed, at the quarry of Mr. John Smith, though near the mill it is reduced to ten or fifteen feet. Throughout the most of that interval, a heavy debris covers it from sight, the overlying Niagara only being visible along the top of the bluff. The Niagara has a dip of five or six degrees to the southwest, and passes below the lower

In the southeast quarter section 33, York, about forty rods north of the state line, is a very small exposure of the Niagara, in the bottom of a ravine, with the Devonian in the enclosing hillsides. A slight opening has been made in these beds, which are very porous and light colored, and about three inches in thickness. Although no fossils were found here to identify the formation, the presence of a very different rock, well known as the Devonian, in the hills and ridges surrounding it, as well as the strong resemblance it bears to the Niagara at Lime Springs, will allow of its being regarded only as the Niagara limestone.

The Devonian Limestones.

In the report for 1874 the Devonian limestones were described as occurring at Le Roy, in Mower county. It was then supposed that those limestones extended but a short distance east of Le Roy. They have been found during the past summer to extend considerably further east, and to embrace an area in Fillmore county fully ten miles wide on the southern border. Along the western boundary of Fillmore county the width of this Devonian belt is not certainly known, but it has about the same width as on the southern. Hence the eastern boundary line of the Devonian in Mower county should run from about section 13, Bennington, northwestwardly to about section 7, in Pleasant Valley. The Silurian area, as laid off on the map of that county, should probably embrace the Niagara, the Maquoketa and the Galena, overlain, in the northeast, (Racine) by the Cretaceous.

The Lower Devonian limestones are very different from the Upper, at least lithologically. Dr. White has classed them all as Hamilton. But there seems to be some reason for separating them into at least two parts, the upper portion, which contains more shale, being the probable equivalent of the Hamilton, and the lower, which greatly resembles the Lower Corniferous, of the Ohio Geological Reports. The distinctively Onondaga features of the Ohio Corniferous are the only ones seen in Fillmore county. The color of this limestone is like that of the Galena, but its even and non-vesicular texture is enough to distinguish it from that at a glance. The bedding is also less thick, being, when in exposure, usually less than eight inches, though when quarried it is in heavy beds. It is a yellowish, magnesian limestone, sometimes with a finely siliceous composition, and is suitable for most purposes in common masonry. It is tolerably free from calcite lumps, but has some chert nodules. It has a few fossil brachiopods, as *Atrypa*, and an incrusting bry-

posing about ten feet. At Hopkins' quarry, situated two miles west and a little south of Lime Springs, about twelve feet, in heavy layers, can be seen, without fossils, but holding some flint. Dip southeast. At Chester similar beds are exposed, near the mill, three-quarters of a mile south of the state line. It is here in heavy beds, of a soft, uniform, granular texture and yellowish color, useful for a cut stone.

This rock is probably that which is said to appear in the river banks, section 34, Beaver, on Jerry Kingsley's land.

Southeast quarter section 20, Beaver. This rock is again seen here, exposed along the banks of Slough Creek; owner's name unknown. It here shows a brachiopod resembling *Orthis*, and a radiating *Fenestella*. It is in the midst of an uninhabited prairie, and only weathered pieces can be found.

Southeast quarter section 18, Beaver. About ten years ago a cellar, dug for a farmer's residence, furnished stone of the same kind in sufficient quantity to construct his house, now owned by Mr. James Smith. Similar rock again appears in the road, northwest quarter section 20, Beaver, but is somewhat more vesicular.

Widow Scarrie has a small quarry in a yellowish, fine-grained rock, almost non-fossiliferous, and probably of the Lower Devonian, on the southeast quarter section 28, Bloomfield. Outwardly this much resembles the Cretaceous sandstone, as exposed at Austin, in Mower county, but it has a doubtful brachiopod that appears like *Atrypa*. Its weathered color, its homogeneity and fineness of grain, its irregularly rounded cavities, containing loose, ochreous dirt, combine to make it Cretaceous. It is with some doubt classed as Lower Devonian.

This limestone is found in loose pieces, and often in surface exposures, on the tops of knolls, near the state line, sections 33 and 34, York, the porous, white Niagara appearing in the ravines.

The Cretaceous.

No attempt is made to map out the Cretaceous area in Fillmore county, inasmuch as it is all embraced in the drift-covered portion, and but one or two localities of its existence are known. It probably extends no further east, however, at any point, than the east side of the first tier of towns along the western border of the county. Its area is most reliably indicated by the surface features, in the absence of actual outcrops. Guided by this only it is supposed to occupy the flat and prairie portion of Sumner Township, stretching southward through Spring Valley and Bloomfield and covering the most of Beaver, and perhaps portions of York. Judging from the prevalence of Cretaceous features in the drift-clay exposed in the railroad cut at Lime Springs, it has played an important part in originating the materials of the heavy drift covering that spreads over not only the western portion of Fillmore county, but all the counties of the state further west.

The lower portion of the Cretaceous, which is that represented in Minnesota, consists of sandstones and lignitiferous clays or

shales—the sandstones lying at the base of the formation and being the same that Dr. White has denominated in Iowa the "Nishnabotany Sandstone." Above this sandstone, which is often white and incoherent, with a thickness of about one hundred feet, so far as observed, is a clayey member of the Cretaceous which has been identified by Mr. F. B. Meek as the Fort Benton Group, of Messrs. Meek and Hayden. This is well exposed in the region of the Upper Minnesota Valley, and contains some impure lignite, and is found in small pieces disseminated with its fossils, through the drift-clay cut at Lime Springs, a couple of miles south of Fillmore county, in Iowa. The Niobrara, or chalky member of the Cretaceous, may also exist in the extreme western portion of the state.

So far as Fillmore county is concerned the presence of the Cretaceous is known more by certain indirect or secondary evidences, than by the actual discovery of its beds *in situ*. In the extreme northeastern corner of Mower county it was struck by a farmer in digging a well. It there has the form of the fine-grained sandstone seen at Austin. The surface features that prevail at that point pass into the northwestern corner of Fillmore county, and cover the most of Sumner Township. Southward, at Spring Valley, a similar stone appears in the north side of the creek where it has been opened for building purposes by Messrs. James Wilder and Henry Thayer. It is here a fine-grained, argillaceous sandstone that cracks and crumbles on freezing It has been given up as worthless for building material. Near the same place, on David Higby's farm S. W. ¼ sec. 32, is a very fine and tough clay, of a generally bluish color, almost entirely free from grit, which is spread out over a wide area lying but few feet below the surface. The overlying soil which is annually plowed, is a black loam, (rather clayey) varying below to a yellow, clayey loam. This clay was discovered several years ago, but nothing has been done that will demonstrate or indicate its real orgin, though it is evidently not a part of the drift. It has the appearance of being suitable for pottery or for brick, but would require some sand. A soapy, variegated clay also occurs at J. W. Smith's brick yard, two miles northwest of Spring Valley, though drift clay, with some gravel, is used in the manufacture of brick. A similar clay is met in abundance at Spring Valley village, but it is mingled with limestone fragments and drift materials.

Besides these clayey deposits, which are believed to have resulted from the degradation, or more or less perfect preservation, of the lower Cretaceous clays, there are a number of white sand deposits in the same portion of the county, which probably are referable to the incoherent layers of the Nishnabotany sandstone. One of these occurs north of Mr. J. W. Smith's brick yard, on section 17, Spring Valley. Another is situated on C. C. Temple's land, southeast quarter of section eight, Bloomfield, where it is 20 feet thick at least having been tested to that depth, the bottom never having been reached. It here occurs in an open prairie country, and is known to spread out over many acres, lying but two or three feet below the surface. It lies on the Galena, of course unconformably. It is not a purely white sand, like the St. Peter, but yellowish white. It

is sometimes very fine, but varies to coarse. Another deposit of this sand is on Mr. Andrew McNee's land, northwest quarter section 22, Bloomfield, and still another on J. M. Rexford's, northeast quarter section 36, where it has been opened, as at the other points named, and used for mortar. These are situated in an undulating tract, with some shrubs and trees. These sand beds are not regarded as belonging to the Cretaceous rock *in situ*, but as being copious local products, under drift agencies, of the Cretaceous. Sometimes they embrace lumps of clay, of a greenish color, like the Fort Benton, and sometimes they show oblique stratification. They are entirely uncemented, so as to be shoveled directly into the wagon. Another singular deposit, in the same manner referable to the immediate presence of the Cretaceous, occurs on the southwest quarter section 15, Bloomfield, land of Peter Peterson. Here a series of knolls, which embrace, indeed, that in which is Mr. Andrew McNee's white sand pit, and are covered with aspen and hazel brush, are found, many of them, to be composed of a beautiful, coarse gravel, the greater part being white, often limpid, quartz, the size of the pebbles varying from that of a pea to that of a hazelnut. On these knolls are a few northern drift boulders, and no doubt the gravel was also placed in the position it now occupies by the drift forces. This gravel, so remarkably homogeneous, like the white sand deposits mentioned, can only be referred to the immediate proximity of the lower Cretaceous. It could not have been far transported without being mixed with other rock material. It distinctly points to the existence of a coarse gravel or conglomerate in the lower Cretaceous, which has not yet been discovered. It indicates also the littoral nature of the Cretaceous beds from which it was derived.

There is still another indirect evidence of the existence of the Cretaceous in the western portion of Fillmore county. There are heavy deposits of limonite iron ore, bearing some unascertained relation to the Cretaceous, or to the drift found in the southwestern part of the county. In the Second Annual Report of the Survey mention was made of the occurrence at a number of places in the Minnesota Valley, and in that of the Blue Earth, of a coating of iron ore on the Lower Silurian rocks, where they are unconformably overlain by the Cretaceous. Dr. Shunard says of this: (*Owen's Geological Survey of Wisconsin, Iowa and Minnesota, page* 487.) "The nodules of iron ore have mostly a concentric structure, and appear to be of good quality. The superficial indications render it probable that this bed of iron ore may be both extensive and easily accessible." In Fillmore county a discovery was made by Mr. C. C. Temple, in digging a well near his sand pit, already described, and referred to the Cretaceous as its probable source, which throws some light on the manner of occurrence of the limonite referred to. He testifies that *this bed of iron ore is at least thirty-six feet in thickness.* In his well, which is six feet circular at the top, he dug down about eighteen feet, when he reached rock, fragments thrown out revealing the Galena limestone. He describes the rock as occupying but about one-half of the diameter of the shaft he was dig-

ging, which afforded great quantities of soft limonite, or ochr He drilled into the iron ore a depth of thirty-six feet. A number wells in the vicinity of Etna, a few miles further southeast, al struck a similar iron ore. On section 36, Bloomfield, a great ma loose pieces of porous limonite are found in the fields, having be plowed up in the soil. The county surveyor, Mr. J. Gregor, al found it impossible to lay out the quarter sections of that secti in the usual manner, by the use of the magnetic needle, though t original United States surveyors record no unusual disturbance the magnetic needle. Limonite iron ore is regarded usually as no magnetic. In large quantities, near the surface, it seems to inf ence the magnetic currents. What relation this ore bears to t Cretaceous is not known, except that it has been found to over the Silurian rocks, or to cover their surfaces with a scale where t Cretaceous overlies them unconformably. Further and more mi ute observations in other places may reveal its real source and value. The reader is referred to the Second Annual Report for account of the *Cretaceous over the Lower Silurian* at Mankato, the Valley of the Minnesota.

The Drift.

The drift presents some interesting features in Fillmore count The western limit of that well-known tract denominated *The Dri less Area*, by Prof. J. D. Whitney, crosses this county. This bour ary is not well-defined. There is a very conspicuous absence the bluish clay, and the northern boulders that distinguish the tr northern drift sheet of counties further west and north, throughc the eastern two-thirds of the county; the boundary line running s proximately, from the southeast corner of Bristol township to t northeast corner of Jordan. West of that line, which is modifie in its course, by valleys and uplands, is a belt of five or six mi in width, which is characterized by an overlapping of the lo loam on the thinning out edge of the drift sheet. This belt characterized further by peculiar local modifications of the ma rials of the drift, due to the underlying rock, as mentioned und the head of *Cretaceous*. West of this belt the true drift becon prevalent, consisting of clay, with many boulders.

That tract which is regarded as driftless,* is, so far as Fillm county is concerned, not without some evidences of having be subjected, at some time, to a force similar to that which is suppos to have deposited the great drift-sheet of the northwest. The are isolated patches of gravel, with small stones, sometimes c mented into a crag, which have been noted in Fillmore count scattered sparingly over the eastern part of the county, as the f lowing field minutes will show:

Drift pebbles are in the street, north of the schoolhouse, southwest qu ter section 22, Amherst.

Drift occurs in the form of gravel and boulders, some of them a foot diameter, southwest quarter section 4, Fountain, on the east bank of Sug

*J. D. Whitney, Geology of Wisconsin, Vol. 1, pages 114-139.

Creek, in the road; seen in going east from the quarry of Enoch Winslow. At Fountain village there is said to be no drift between the loess loam and the rock.

A little drift may be seen at the Tunnel mills, section 34, Sumner.

There is a little fine drift visible along the road, southeast quarter section 25, Sumner.

At Chatfield there is some gravelly drift, with small boulders, visible in the street, near the millrace.

Drift, with pebbles and stones, appears about a mile south of Clear Grit, on the Shakopee terrace along the highway.

Also on the road to Carimona, near Preston.

About midway between Preston and Carimona, a wash by the roadside revealed—

Loam	8 feet.
Gravelly, red loam	3 feet.

With no distinct separation, a few small boulders lying in the water course below.

At Carimona a thin layer of drift is usually found under the loam.

The same is true at Forestville.

At Spring Valley the drift is so prevalent that the surface of the country is smooth, and has a lighter colored soil, with much more clay. There are but few stones or gravelly patches. The loess loam is hardly noticeable. One large boulder lies at the street corner, half a mile south of the corporate limits.

Between Baldwin's mill, section 21, Forestville, and the state line, due south, the country is one of drift prairie, nearly the whole distance, with stones and boulders, some of the latter pretty large.

At Ætna, section 36, Bloomfield, among a variety of stones pertaining to the drift, may be seen an occasional one that is *glaciated.*

At Lime Springs and Foreston, a few miles south of the state line, on the Upper Iowa river, the drift is abundant.

At Granger there is a light drift, and also where the road turns north to Preston, northeast quarter section 36, Bristol; but it becomes lighter still or entirely invisible, in traveling to Preston. In its place a heavy, rich loam, rather clayey, covers the country, and smooths it off almost as effectually as if drift-covered. A well, being dug about five miles south of Preston, on the high Trenton area, passes through this loam eighteen feet before striking the rock.

The drift is very thin at Lenora, if not entirely wanting.

About four miles southeast of Preston a large green, dioritic boulder may be seen lying in the loess loam, in the road, and a red quartzose pebble. The pebbles that appear in gullies by the roadside, in the loam area, are generally of chert, from the rock of the locality. It cannot be ascertained whether this dioritic boulder lies on other drift deposits, but it is surrounded laterally only by the loam.

At Elliota is a thin drift, in the form of pebbles, the largest being three or four inches in diameter. Thence northeastward to Newburg nothing but the yellow loam is observable. Between Newburg and Riceford, situated on the western edge of Houston county, no northern drift is visible; but at Riceford, which lies in a deep and narrow gorge, a few drift pebbles occur in the street.

About the center of sec. 29, Holt, is a deposit of drift gravel. It may be seen in descending the hill northward, just before the road forks to Whalen and Lanesboro. It is considerably cemented by lime, forming a crag, large lumps of which, some 18 or 20 inches thick, have been used for embankment on the lower side of the road. In some parts it is quite fine, and useful for mortar, for which it has been hauled away. It is at least ten feet thick.

There are boulders in the valley of Duxbury creek, sec. 28, Preston.

Sec. 19, Pilot Mound. In the road going to the river from the south, are a lot of boulders and other drift. The same can be seen on the north side,

going up from the ford. The deposit seems to be five or six feet thi gradually mingling with, and finally becoming replaced by the loess loam.

Drift gravel and stones are seen along the road in going down the hill Isinours, from Preston.

Drift pebbles and clay occur at the crossing of Watson's creek, on t direct road between Fountain and Preston, and on the terrace of the Sh opee limestone, a quarter of a mile south of the creek.

Boulders are seen at Spring Valley, and on Mr. Kleckler's farm, two a a half miles east of Spring Valley.

An occasional boulder is seen in the river valley at Geiner's Mill, sec. Jordan, but the most of the surface covering on the rock, in the high prai region, seems to be of loess loam.

East of Highland P. O., in Holt township, sec. 36, is a conspicuous depo of drift, exposed in the road, in the form of a stony gravel. It lies on t brow of the Shakopee terrace.

It is noticeable that in nearly every instance where drift pebbl occur in the region known as driftless, they lie on or are very ne an outcrop of firm rock. They frequent the brows of the terra formed by the Shakopee limestone. The above named localities a nearly all embraced within the boundaries of the driftless tract, already defined in Fillmore county. These patches of northe drift present the appearance of greater age than the drift of t western portion of the county, and are believed to belong to a gl cial epoch that preceded the epoch that produced the great dr sheet of the northwest. An "interglacial epoch" separated the It was probably during that interglacial epoch that grew the pe and coniferous vegetation that has been found in considerat abundance embraced within the great drift sheet, (or at least bel fifty feet of drift materials) round its outer margin, as mention already in a report on Mower county, and as further demonstrat in Fillmore county. It is this older drift that is covered deeply the loess loam, and *it is within the loam-covered portion of the cou that true river terraces, of alluvial composition, are found.* (Co pare *Geology of Ohio, Vol. II., Report on Delaware County.*)

Ancient Peat and Vegetation in the Drift Deposits.

Owing to the great geological interest connected with the disc ery made last year of a peaty bed within the drift deposits Mower county, a careful search was made in the survey of Fillm county for further information concerning its origin and exact lations.* There were found to be quite a number of places in t western portion of the county where farmers, in digging wells, h struck this bed of vegetation. No opportunity has been afford to make a personal inspection of this bed, and owing to the ind niteness of the information derivable from the farmers themselv and its contrariety, it is thought best to give only the statements Mr. Calvin E. Huntley, of Spring Valley, a professional well-drill Throughout the whole of the county there is much difficulty in taining ready water for farm and domestic use, and a great ma

* For further information on the subject of vegetation in the drift deposits of the no west, the reader is referred to a paper by the writer in the Proceedings of the Amer Association for the Advancement of Science, 1875, Detroit meeting.

wells are drilled deeply into the rock. This is owing to the canoned character of the rock surface, both within the drift area and the loam-covered portion. These canons serve as subterranean drains, though they are generally filled with drift in the western part of the county. Mr. Huntley furnished the following facts concerning this bed of vegetation. Some of these localities are within the limits of Mower county:

Northwest quarter section 6, Beaver. Land of Andrew Oleson (Early.) It was found here at the depth of thirty feet, situated on a ridge in prairie country. It was two or three feet thick, and had a blue clay both above and below it --then struck a lime rock.

N. E. ¼ sec. 12, Le Roy, Mower county. Land of D. B. Bosworth. This was also on a high ridge, with blue clay above and below it, and lay at the depth of about 25 feet below the surface. It had a depth of seven feet, and contained "decayed stuff, like pressed hay."

N. E. ¼ sec. 1, Le Roy, Mower county. Land of Ole Knutson (Stoley): found at the depth of thirty feet; five feet thick; blue clay above and two feet of black clay below; then lime rock.

Sec 30, Bennington, Mower county, on land of Gents Everson. This is situated on a flat, and was found from 30 to 32 feet below the surface. It was three feet thick, and lay below blue clay. Below it was gravel to the thickness of eight feet, when the well struck lime rock.

S. E. ¼ sec. 9, Bennington, Mower county; land of John Mehan It here had blue clay both above and below it. and a thickness of two feet. It lay at the depth of twenty feet. The underlying blue clay was gravelly.

It was met in the same town on Robert Cooper's land, at the depth of twenty-five or thirty feet. It was here on a very high ridge. It was in a blue clay, with gravel both above and below. It was here three or four feet thick. This well was abandoned on account of quicksand.

On the slope, northeast from Mr. Cooper's, it was reported to have been met with at the depth of six or seven feet from the surface, on the land of Mr. Bass.

Sec. 2, Sumner. Land of Wm. Bailey: met a deposit which was embraced between layers of what was then supposed to be lime rock. This deposit was two feet thick, and consisted entirely of wood. Rock was struck at the depth of eight feet. This wood was thirty-five feet below the surface. The owner called the rock "grindstone rock." (This was probably the Austin sandstone, of the Cretaceous, and the wood a lignite belonging to same age.)

N. part of sec 28, Spring Valley; land of A. B. Hutchinson. An irony deposit, having an unknown thickness, was struck at the depth of thirty-five feet.

This was also met in the central part of Racine, on the farm of D. Reed, at the depth of twenty-five or twenty-six feet, having a thickness of two or three feet. It came up in chunks which glistened, and looked like iron ore.

Under the head of *Cretaceous* the reader will find further statements concerning this iron ore. Two miles west of Spring Valley, on the land of O. H. Rose, Mr. Leonard made an observation on a deposit of surface crag. This he found abundantly cemented with iron, lying on a sloping surface, covering twenty-five or thirty square rods, rendering the land unfit for cultivation, in the vicinity of no rock bluff, and on a prairie country. Iron ore was thrown out of a well S. W. ¼ sec. 24, Bloomfield. It was said to have come out in chunks, and to be as heavy as iron. It rises to the surface and a plow cannot be passed through it. This is owned by Geo. H.

Smith. Again on H. T. Odell's land, section 36, Bloomfield, it i found in scattered lumps variously mingled with the soil, and wit other stone. These surface pieces are impure, and often hold ce mented gravel and pebbles. They are also loose and porous, an pass into ocher. Similar pieces occur on section 1, Beaver, land o O. A. Boynton.

Wood was taken from two wells in Jordan township, sections 2 and 30, on land of M. Robbins and Geo. Hare. This is also on high prairie. In Mr. Hare's well was said to have been a tree.

Wells.

In order to study further the thickness of the drift, and its lat eral extent in the county, a great many observations were made o the phenomena of common wells, and the tabulated list herewit appended will give the results of some of those examinations. T has already been said that there are a great many subterranea streams, especially within the area of the Trenton limestone. Som of these streams gush out along the river bluffs, and give rise t copious springs. Wherever there is an open rock structure, whic is not imperviously covered by the drift or by the loam, it acts t receive the surface water and to allow its passage along lower level to the main river valleys. This necessitates the drilling of a grea many wells which penetrate in the rock to a depth, sometimes, o two or three hundred feet before reaching water.

Owner's Name and Location.	Drift or Loam, Feet	In the Rock, Ft.	Total, Ft.	Kind o
Public Well, Fountain	12	290	302	
W. H. Strong, Carimona	20	43	63	Good.
Poor Farm, section 4, Canton	22	30	52	Good.
Wm. Holton, Carimona	22	38	60	Good.
J. H. Hall, N. E. ¼ section 9, Bloomfield	41½		41½	Good.
E. Steffins, Spring Valley	6	80	86	Good.
Col. C. G. Edwards, Spring Valley	6	47	53	Good.
Calvin E. Huntley, Spring Valley	7	31	38	Good.
Peter Swab, section 6, Jordan	8 in.	69	70	Good.
Wm Twiggs, 1½ miles S. E. of Spring Valley	10	40	50	Good.
S. S. Belding, Etna	10	22	32	Good.
J. M. Rexford, N. E. ¼ section 36, Bloomfield	20	75	95	
James Smith, S. E. ¼ section 18, Beaver	5	50	55	Good.
A. C. Seelye, Lenora	20	55	72	Good.
M. L. Potter, Lenora	90		90	Good.
Old town Well, Lenora	About 20		55	
Wm. Barton, 1½ miles N. of Lenora	20	110	130	
James Walsh, section 20, Amherst	13	67	80	
Wm. Kimber, S. W. ¼ section 29, Amherst	34	82	116	
S. S. Stark, N. W. ¼ section 2, Amherst	28	100	128	
Henry Rose, N. E. ¼ section 3, Amherst	25	117	142	
Public Well, Highland P. O			65	
Andrew Vogt, S. W. ¼ section 20, Amherst	7	85	92	No wat
Mrs. Simmons, section 35, Spring Valley	8	35	43	Good.
Public well, Spring Valley	12	2	14	Good.
A. N. Hart, Spring Valley	14	6	20	
S. W. Knight, section 11, Fillmore	15	95	110	Tolerab
S. Hoff, Fillmore	18	8	26	Good.
D. S. Hoff, Fillmore	18		18	Good.
John Kleckler, S. E ¼ section 26, Spring Valley	4	27	31	Good.
F. Greaves, Chatfield	10	40	50	Good.
Th. Simpson, Chatfield*	9	31	40	Good.
W. H. Dunham, Chatfield township	10	50	60	Good.
Elisha Leonard, section 14, Sumner	17		17	Good.
J. B. Silbert, 2 miles E. of Spring Valley	19		19	Good.
C. B Brocksom, 2½ miles E. of Spring Valley	16	33	49	Good.
F. Lageirg, 3 miles E. of Spring Valley	About 20	32	52	Good.
J. H. Hall, 2 miles S. of Spring Valley	27	14½	41½	Good.

The price charged by Mr. Huntley, of Spring Valley, for drill wells, is one dollar per foot the first fifty feet, with twenty-five ce per foot added every ten feet thereafter. Messrs. Sands & Tous Amherst, receive fifty cents per foot before striking the rock, dollar and twenty-five cents per foot for the first twenty feet in rock, and add twenty-five cents per foot every ten feet.

The Loess Loam.

The greater portion of the county is covered with this loam. contains no gravel or boulders, or with very rare exceptions, consists almost entirely of fine siliceous material which become some places quite clayey, making a very slippery mud when This in outward appearance is of a light, yellow or rusty color, differs in that respect from the loam seen on the drift-covered tion of the county which is frequently black, or brown, vary to an ash color when mingled with a considerable per cent. of from the drift, and also contains gravel. The loess-loam is homogeneous over wide tracts, while that in the drift area is sub to local and sunden variations. The loess-loam is indistin stratified, especially in the valleys, but the usual appearance is of non-stratification. This stratified arrangement is rendered less evident from the great similarity of the materials from the to the bottom. It does not consist, apparently, in any change f coarse to fine in the sedimentation, but in a *lamination* of homogeneous clayey, loam, and is easily obliterated by exposure by trickling water. This condition was noted particularly at P ton, and indicates that it was deposited in still, or gently mov water. Where this loam lies over the old northern drift, it through a gravelly stage, the materials of the loam mingling the coarser portions of the drift, and becoming finally replaced the drift. The drift patches covered by this loam, pertaining to eastern and central portions of the county, and believed to bel to an earlier drift epoch, are, so far as seen, made up of gravel sand, with small stones. *No drift clay*, like that which covers western part of the county, has been seen overlain by the lo loam, except that which pertains to the general drift sheet of northwest, and which occupies a narrow belt of 5 or 6 miles w where the loam overlaps the later drift. It would be reasons however, to expect that some such clay would be found. pebbles that are thus mixed with the lower portion of the loam smooth and waterworn, not covered with a coating of dec material of the same nature as the pebbles themselves, as would be expected to be if the loam were derived from the de *in situ*, of the materials of the drift. The thickness of the lo loam sometimes reaches twenty feet in the open upland, and, u favorable circumstances, where it might have accumulated later as well as perpendicularly, it is much more. It is tickest in eastern part of the county.

Alluvial Terraces.

At Preston, besides the flood plain, the river has a high terrace-plain. The Stanwix House stands on it. It consists of loam undistinguishable from the loess-loam that covers that portion of the county. The same may be seen at Lanesboro, and at Whalen, but it is not conspicuous. At Rushford fragmentary remains of this high terrace are seen in the valleys of the tributary streams. Along the main valley they are not well preserved. There are two terrace levels, besides the flood-plain. The highest terrace plain is from 70 to 80 feet above the second, and about 130 feet above the river. The lower terrace, on which Rushford stands, is about 40 feet above the river, and is probably never reached by the river in even the highest water. Within this lower terrace-plain, which spreads out laterlly and forms the most of the alluvial land between the rock-bluffs, is the river channel, and a still lower flood-plain about 20 feet above the river at low stage. A similar high terrace is seen along the Mississippi river at Winona, in Winona county, rising about 95 feet above the river, while the flat on which the city of Winona stands is about 25 feet above the river at the boat landing, in low stage of water. At Rushford and Winona the high terrace consists of a material different from the loam that overspreads the country, being made up of stratified sand. This terraced condition of the valleys of Root river, and of the Mississippi, is confined, so far as observed, to the loam-covered area, which nearly coincides with the "driftless area," as defined and described by Prof. Whitney.

Material Resources—Fuel.

In addition to the products of the soil which will always be her chief source of material wealth, Fillmore county cannot expect any important mineral discoveries to augment her material prosperity. She has a good supply of forest for purposes of common fuel, and will not suffer from the absence of coal, as some of the counties further west have suffered. She will have to depend on her native forest trees, or on those that are being propagated successfully, for the most of her home fuel supply. There is as marked an absence of peat in this county as there is in Mower, but a single locality being noted. That occurs on S. E. ¼ sec. 26, Spring Valley, land of John Kleckler and David Broxlem, and is said to be about four feet thick, covering four or five acres. There is no doubt but other, isolated, small areas, of a turf-peat, also exist in the county, but the circumstances which promoted the production of so large a surface of peat in Freeborn county, are certainly wanting in Fillmore county. The frequency of lakes and swamps, and abundance of peat, coinciding as they do in Freeborn county, taken with the absence of both in Mower and Fillmore, point to the existence of a common cause for these surface features.

Iron.

Throughout the western portion of the county there is a gre deal of surface iron, manifesting itself generally in the form of a c ment in gravel, forming a dark-colored *crag*. There is also mu evidence of the existence of a heavy continuous layer or deposit limonite iron ore a few feet below the surface, in Bloomfield a Beaver townships. The details of these localities, and of the ev dence of iron, so far as ascertainable, have been given under t heads of *Cretaceous* and *Drift*. Should this bed prove to be exte sive, its actual value for commercial purposes may vary great from its intrinsic value. It consists of a loose-textured hydrat peroxyd with ochery impurities, and bears a close resemblan to some bog-ore deposits; but its occurrence on high land, inste of in swamps, necessitates some other explanation for its existen than that ascribed to the occurrence of most bog-ore deposits. may have originated during that swampy condition of Southern Mi nesota when the peat grew that is embraced in the drift deposits, already detailed. It is not probable that it will ever be found va uable for the manufacture of iron. Before the opening up of t vast, and richer, iron ore beds of Michigan and Missouri, the bo ores were considerably used in the production of iron, on a sma scale, in several of the western States, but the small furnaces th smelted them have all ceased operations many years ago. Anoth obstacle to the utilization of this deposit in Fillmore county, will l the lack of fuel in convenient and sufficient quantities.

Lead.

While the Galena limestone, which is eminently lead-bearing Dubuque and Galena, passes, in its northwestern trend, across t southwestern portion of Fillmore county, it has not been discover to afford the same amount of lead as in Iowa and Illinois. Indee at points more remote from the Mississippi river, in Iowa, no r markable deposits of lead have been obtained from it. There is n a total absence of lead from its layers, since a few localities a known to have afforded it in limited quantities. The same is tr of the lower Trenton; which seems to indicate that the presence lead in the limestones of this region does not depend on the kind age of the formation, but rather on some later, superimposed cond tions that prevailed over the region, subjecting various formatio to the same influences.

Quicklime.

All the limestones of the county are suitable for quicklime, b by far the greater quantity is made from the upper Trenton. In t townships of Sumner and Spring Valley, all the circumstances n cessary for the cheap and rapid production of quicklime of the be quality co-exist, viz.: a suitable limestone, abundant exposure, a plenty of fuel. The Trenton there forms some of its characteris

outcrops, constituting the bluffs of the streams continuously for many miles, and rising a hundred or a hundred and fifty feet above the valleys. The kilns are built at the foot of the bluff, and the stone is cheaply obtained, without much cost of transportation. Wood is also abundant at present, much of that portion of the county being covered by a heavy forest growth.

The following list of lime-burners, with their localities and estimated production for the year, will give some idea of the extent of the business now carried on:

Palmer and Miller, Bear Creek, three kilns	2,000 bushels.
N. E. Fetterly, Bear Creek, three kilns	5,000 bushels.
L. G. Odell, Bear Creek, three kilns, (one draw-kiln)	5,000 bushels.
Charles Gorton, Bear Creek, one kiln	1,000 bushels.
Allen Brothers, Bear Creek, one kiln	1,000 bushels.
J. Finley, Bear Creek, one kiln	2,000 bushels.
Isaac Kegley, Bear Creek, one kiln	600 bushels.
Lem. Stout, Bear Creek, one kiln	2,000 bushels.
T. J. Hammer, Bear Creek, one kiln	2,000 bushels.
Elder Cyrus Young, Bear Creek, two kilns	Not in use.
Harvey McQuillan, Bear Creek, two kilns	Not in use.
Olds and Braley, sec. 9, Spring Valley, one kiln	2,000 bushels.
I. N. Cummings, sec. 11, Spring Valley, one kiln	
J. H. Hall, sec. 12, Spring Valley	3,500 bushels.

These all burn the upper Trenton, and there is no noteworthy difference in the quality either of the rock or of the lime produced. According to the testimony of several, however, there are certain layers, near the bottom of the formation, which are not suitable for quicklime. Some layers also are arenaceous, and have to be avoided, but the great mass of the rock is exceedingly well adapted to making quicklime.

The kilns used are, for the most part, of the rudest construction, presenting no improvement over the ancient and well-known "pot-kiln." They have to be emptied and refilled for every burning. Mr. L. G. Odell has the only draw-kiln seen in the county. In this part of the county, mixed wood sells for two dollars or two dollars and fifty cents per cord. The average price of lime is twenty-five cents per bushel, but it fluctuates from twenty to forty. In July, 1875, it was selling for twenty cents; but in September it brought forty cents. The lime itself is generally nearly white after being burnt, but in some places it has an ashen white color, though on slacking it is always white. It slacks with rapidity, evolving considerable heat. It requires from sixty to seventy-two hours to burn a kiln, depending on the size of the kiln, and somewhat on its shape, and consuming about ten cords of dry mixed wood. When freshly and thoroughly burnt, one bushel by measure weighs about 75 pounds, but if not well burnt, it will exceed 80 pounds. "Delivered at Spring Valley, by weight it is sold at the same price as by measure at the kiln." When shipped from Spring Valley it generally goes west, to points along the Southern Minnesota railroad, and is known as *Spring Valley white lime.*

Throughout the county, where the Trenton limestone appears,

there are other lime-kilns that supply the local demand. The lowing were noted:

At Carimona, by William Renslow.
At Forestville, by Frank Turner.
At Chatfield, by Dennis Jacobs.
Sec. 35, Carimona, by Mr. Rollins.
Sec. 25, Canton, by Simon Houck.

The Shakopee is not used for making lime in Fillmore cou though it is extensively burned in the lower Minnesota valley, Mankato and at Shakopee. The St. Lawrence limestone is so what employed for this purpose, and affords a lime that is ne white, and is said to weigh 80 pounds per bushel of measure. Lanesboro this lime sells at $1.25 per barrel, or fifty cents per bu el, wood costing five or six dollars per cord. Mr. Sherman's l holds about 300 bushels, and requires 10 to 11 cords of wood thorough calcination, burning about 48 hours. But little is ship from here. The lime is about white, and slacks perfectly wh The following list embraces all known kilns that are run from St. Lawrence:

At Lanesboro, by B. Sherman.
At Lanesboro, by Moses Greer.
At Lanesboro, by Mr. Butler.
At Rushford, by Jos. Otis.
At Rushford, by Wm. Crampton.

Brick.

There is no lack of materials for making common red brick. some places the surface of the drift clay is used, containing s fine gravel, and at others the loess-loam. Brickmaking machin was met with in the survey of the county at the following point

Sec. 20, Spring Valley, J. W. Smith.
Forestville, Michael Shields.
Preston, Franklin Coleman.
Lanesboro, Thomas Dunsmore.
Chatfield, Wm. Stafford.
Lanesboro, W. H. Roberts.
Rushford, Ole Tuff.
Granger, (formerly,) Mr. Ferris.
Peterson, ———.

Gold, Copper.

In small quantities gold has been washed, by rude methods, f the drift at several points in the county. It was found on I Hague's land, in gravel, northeast quarter section 26, Spring ley, and at Yeariton's saw mill, section 31, Jordan. There ar counts also of fragments of native copper having been found in drift. It is hardly necessary to say that these discoveries do indicate any valuable deposit of the kind in the rocks of the lo

ties where they may be found. They pertain to the drift, and have been transported hundreds of miles along with the other foreign substances in which they occur, from the northern part of the State. Such discoveries have sometimes awakened an interest that has culminated in stock companies formed for mining, and in the wasting of thousands of dollars. Similar small quantities of gold can be got by a minute washing of the drift at almost any place where the drift sheet is attenuated, or where the older glacial drift has been denuded, leaving the gold, which is indestructible, either by the lapse of time or by the chemistry of the elements, on the rock surface underlying. Almost every geological report in the country makes mention of them, extending at least through Ohio, Illinois, Indiana, Wisconsin and Iowa.

Building-Stone.

With this necessary article Fillmore county is also well supplied, and it has been put to an extensive use. There are hundreds of openings made to supply a local demand, besides a great many more extensive quarries which are known for a good many miles round. A great deal of stone for building is shipped to counties west, which are drift-covered, and without accessible building stone. Probably three-fourths of the building-stone used in the county is derived from the Trenton, the other fourth being made up of the Galena and the St. Lawrence. The Lower Trenton is most frequently employed. This is largely owing to the prominent manner of its outcrops, as shown under the head of *Drainage* and of *Surface-Features.* The Upper Trenton has been used in the construction of several schoolhouses and private residences. At Spring Valley the Galena is principally used. At Lanesboro, Whalen, Peterson and Rushford, the St. Lawrence. The Shakopee and Jordan are but rarely resorted to.

Probably the best known quarry in the county is that of Mr. Joseph Taylor, near Fountain. It is situated near the railroad, from which a side track allows the loading of cars. It is in the Lower Trenton, and supplies the "blue limestone" that is so largely shipped by the Southern Minnesota Railroad to points on its line in Mower, Freeborn and Faribault counties. The beds are usually less than six inches in thickness, and they are easily broken to any desired size. It is a hard stone, not easily cut, but can be dressed if necessary. It is not injured by disseminated shale, as much of the Lower Trenton is, and hence makes a very durable material. Mr. Taylor delivers it on the cars at $4.50 per cord of 128 feet. At Fountain are several buildings constructed of this stone.

Besides the quarries in the Trenton that have been mentioned in giving the scientific geology of that formation, a number were visited at which no new facts of interest were noted. Such were Ole Oleson's, northeast quarter section 36, Harmony; Wm. Wilbright's and Martin Quinn's, section 15, Forestville: George Drury's, section 3, Bristol; Garrett Mensing's, southwest quarter section 27, Forestville. It would be impossible, and unnecessary, to mention

all the places where this limestone has been wrought. In trave over the county a number of stone houses for residence were s belonging to farmers. Such are O. O'Hara's, southwest qua section 18, Amherst, from the Trenton; Mr. George Park's, sec 37, Bloomfield, from the Galena of Mr. S. S. Belding's qu The stone mill at Preston is of the Trenton. Of the quarries i Galena at Spring Valley, those of Mr. Shumaker and of Mr. A are the most important. The former furnishes a beautiful grained cut-stone for trimmings, as well as stone for common w The latter supplies a darker-colored, and coarser stone, which been considerably used.

From the St. Lawrence limestone a very fine building stone i tained. It is a fortunate circumstance that very much of this ation is in regular, and often in heavy layers. These are also so firm as to resist the usual means for quarrying. When the are broken the blocks are found to possess often a finely vesic texture. Their color is a very light yellow, or buff, resembling of the well known "Milwaukee brick." The principal buil at Lanesboro, including the Lanesboro Hotel, the flouring m Thompson & Williams, the Presbyterian and Catholic churches, public schoolhouse, and a number of stores, are of the St. L rence, quarried at Lanesboro, and from land owned by the L boro Company. At Whalen are excellent opportunities for ob ing this stone in its best condition. It has been somewhat wro on Whalen's Bluff. Quarries in the same are owned at Rushfo Wm. Crampton, Jos. Otis and Hiram Walker. Mr. Cramp quarry furnished the stone put into Boyam's store, and also th A. K. Hanson's. Mr. E. Larson's was built from Mr. Otis' qu and that of Kierland & Son from Mr. Walker's. At Amherst the Jordan is quarried some for foundations, and the Shakope Chatfield.

Sand for Mortar and Concrete.

Wherever the St. Peter sandstone is accessible it is employe making mortar. It is equally good for hard-finish, being, wh ken from some depth, purely white and of very uniform fine There are, however, some portions of the county where it is more difficult to obtain a sand suitable for common mortar. I western part of the county a white sand, or one nearly white i tained from deposits referable to the Lower Cretaceous. T have been mentioned under the head of *Cretaceous*. They are f on the land of C. C. Temple, southeast quarter section 8, Bl field, on section 17, Spring Valley, on Andrew McNee's land, n west quarter section 22, Bloomfield, and on J. M. Rexford's, n east quarter section 36. Mr. Temple deliver's sand at Spring ley for $1.75 per load, of two tons. One team can haul five loads per day, but generally hauls but three. From three to hundred dollars worth are taken from Mr. Temple's sand pit a ally. Besides these sources for mortar-sand, the Jordan sandst which is often as incoherent as the St. Peter, can be used to ad

tage, though it is rather more apt to be cemented by iron. Ther
can be no question but the compact and impervious nature of th
[redacted] of the lower Trenton have preserved the incoherenc
[redacted] the downward percolation of ferri

hundred dollars worth are taken from Mr. Temple's sand pit annually. Besides these sources for mortar-sand, the Jordan sandstone, which is often as incoherent as the St. Peter, can be used to advan-

tage, though it is rather more apt to be cemented by iron. There can be no question but the compact and impervious nature of the green shales of the lower Trenton have preserved the incoherency of the St. Peter, by preventing the downward percolation of ferriferous and calcareous waters, which certainly would have left their impurities in the form of cement among its beautiful white grains.

The proximity and cheapness of lime and sand have suggested the building of houses by mixing these substances in the form of a concrete. Several such are found at Fillmore, also in Jordan, and at Rushford; but this method is not general. The material is cast in the form of large brick, having the color of common brown mortar, and these blocks are laid up much like common brick walls. Patent presses are used to make the concrete blocks.

REPORT ON OLMSTED COUNTY

BY M. W. HARRINGTON.

This large and wealthy county lies in the second tier of cou north of Iowa. It is separated from the Mississippi Rive Winona county on the east. Fillmore and Mower counties o south separate it from Iowa. It is bounded on the west by D county and on the north by Goodhue and Wabasha cou Olmsted county is nearly a rectangle with five ranges of town east and west and four ranges north and south. The geome figure is rendered irregular by Wabasha county which takes ou townships from the northeast corner. This irregularity is fa increased by an east and west row of twelve townships o western part of the south side of the county, and extending h section farther west than the rest of the county. The county tains 18 complete townships of 36 sections each, and twelve tions in addition, making 654 sections or square miles in all.

The following table gives the area in acres of each of the ships of the county. It is from the office of the State Au Hon. O. P. Whitcomb:

Township N.	Range. W.	Acres and Fractions.
105	11	23,008.69
106	11	23,019.01
107	11	23,038.81
105	12	22,992.58
106	12	22,983.90
107	12	22,977.97
105	13	23,020.18
106	13	22,963.10
107	13	23,005.91
108	13	22,810.11
104	14 (6 sections)	26,804.42
105	14	
106	14	22,973.76
107	14	22,915.45
108	14	22,968.06
104	15 (6 sections)	26,809.22
105	15	
106	15	23,002.35
107	15	22,990.60
108	15	23,057.89
.....		421.341.96

ntiful and their fall moderate. The
by three paths. The central, north-
county are drained by the Zumbro
h into Wabasha county, when it turns
Mississippi. It comes into Roches-
thin the city limits Bear Creek, from
m the east, and Cascade Creek, from
r the north line of the county it re-
g from the union of the Middle and
The southern tier of townships are
very sinuous, takes a generally east
has in the county no affluents of any
e a stream of small size comes in
n border of the county some branches
reach this county.
unty. There are a few small ponds
name of lakes. Streams which sink
are said to be not rare. The U. S.
township lays down one such stream.
maps in Elmira township; and an-
ownships. From reports in various
they prevail where either the Lower
limestone occurs—a state of things
noted when these formations are

water, of the best quality, are not
ommon on the south or west sides of

bluffs, where the green clay of the lower part of the Trenton Limestone comes to the surface. This clay is impervious to water. The formations dip slightly toward the southwest. The layer of clay forms a nearly level floor of which the southern and western sides are lower than the others. The water will consequently come out on these sides. The springs are frequently of large size. The phenomenon of a row of springs some distance up the sides of a bluff, while the base of the bluff furnishes no springs, is by no means a rare one. Spongy earth is apt to collect about the mouth of the spring. When filled with water, it is soft and very miry. In former times, when the road crossed such spots, bad mudholes were found. They have now been generally tapped and drained, though they are still occasionally met on the less-traveled roads.

Water-powers.—Olmsted county is more than usually favored with good water-powers. This results from the large number of streams, the swiftness of their currents and the favorable nature of the banks and bottom. The information which is given in the following table was derived from Mr. F. T. Olds, of the firm of Olds & Fishback, owners of Rochester City Mills, and from John M. Cole, owner of Zumbro Mills.

Water-Power Mills in Olmsted County.

Name of Mills.	Owner.	Location.	Stream.	Feet of Head.	Run of Stone.	Capacity per day.
Rochester City Mills	Olds & Fishback.	Rochester City	Zumbro	16	4	100 bbls.
Zumbro Mills	Jno. M. Cole	"	Zumbro with Bear Creek	10	4	100 bbls.
Cascade Mills	Lyman Tondro	"	Cascade Cr.	17	2	50 bbls.
Woolen Mill	Wm. Bartley	"	Bear Creek	17		50 hor power, only part improved
Oronoco Mills	Allis, Gooding & Hibberd	Oronoco Vil.	Zumbro	15	7	150 bbls.
Middleton's Mill.	R. Middleton	Kalmar	"	6½	3	35 bbls.
Saw Mill.	Jas. Button	New Haven	"	6		
Stewartville	Chas. Stewart	High Forest	Root	12		50 bbls.
.....	J. Fugle	Orion	"	8		50 bbls.
Custom Mill	— English	"	"	small.	small.	
Quincy Mills		Quincy	Whitewater	10	2 or 3	
Saw Mill	— Ambler	New Haven	Zumbro	10		

Several unimproved powers are reported. There are some between Rochester and the north boundary of the county, but bad bottom and banks prevent their improvement. There are said to be two good powers between Oronoco Mills and the main stream. An unimproved power is said to be found at Genoa. At High Forest village a water-power was improved years ago, but has been permitted to go to ruin.

The *Surface* is much diversified and the natural scenery very pleasing to the eye. The surface is generally rolling. Along the streams bluffs are found sometimes nearly 200 feet high. These bluffs are usually steep, level-topped, and characteristic of the geological formation which makes them. They are most common in

the central and eastern parts of the county. Rochester lies in a valley, with bluffs all around it. It climbs the bluff toward the west. Dover Center, Marion and Chatfield lie in similar valleys. Curious isolated mounds are common, especially along the east side of the Zumbro in the southwest corner of Farmington and the adjacent corners of neighboring townships. They are also common in Elmira. Toward the west the surface is much more level. Much of Rock Dell township is like the prairies just south and west of it. The name of the township is derived from two or three rocky dells in its northern part.

The following notes were taken from the plats of the government survey of the county. These plats were not dated, but according to the State Auditor's records the county was surveyed in 1854 and 1855. They were found in the office of the county register, where access was given to them with the utmost courtesy:

Farmington.—(T. 108 N., 13 W.) This was a prairie township. From an isolated bluff in section 19 extended a stream which sank in about the middle of section 28. The magnetic variation varied from 8° 24′ to 9° 51′. Several marshes of some size were recorded.

Oronoco.—(T. 108 N., 14 W.) No marshes worth noting are shown on this plat. Wood accompanies the streams, varying from one to three miles in extent. The Zumbro on this and other early maps is called the Embarass R. The bluffs along the river are sometimes marked 100 feet. The magnetic variation varied from 8° 24′ to 9° 55′.

New Haven.—(T. 108 N., 15 W.) This township is represented as quite uneven, and bluffs occur along the streams. Woods follow the streams, and two or three aspen thickets are marked. The magnetic variation was 8° 55′ to 9° 54′.

Quincy —(T. 107 N., 11 W.) This was mostly prairie when surveyed. There was some wood along streams, and a few scattering thickets. A single small marsh was marked. Bluffs accompany the streams. Magnetic variation, 8° 27′ to 9° 51′.

Viola.—(T. 107 N., 12 W.) Several small marshes were marked. A range of prairie extended, east and west, through the middle. Prairie also occupied the northeast corner. Bluffs accompany the streams here also. Magnetic variation, 8° 26′ to 9° 34′.

Haverhill.—(T. 107 N., 13 W.) About half of the town is prairie. Woods extend, as usual, along the streams, which are accompanied by bluffs. Several marshes, none of great size, are platted. Magnetic variation, 8° to 9° 41′.

Cascade.—(T. 107 N., 14 W.) There are no marshes laid down in this township. It is nearly all prairie-land, brush accompanying the streams generally, and a few scattering thickets being marked. The bluffs along the river are sometimes quite elevated for the county. Magnetic variation, 8° 13′ to 9° 33′.

Kalmar.—(T. 107 N., 15 W.) Rather heavy timber occupies the northwestern part. An isolated grove is marked in sections 13 and 14. A single marsh is laid down in sections 11 and 12. The banks of the fork of the Zumbro are bluffy. Magnetic variation 8° 36′ to 9° 35′.

30'.

Eyota.—(T. 106 N., 12 W.) A broad belt of timber, about three miles wide, crosses the township diagonally from the northwest corner. The magnetic variation, 9° to 10° 40'.

Marion.—(T. 106 N., 13 W.) Several marshes are given. The land is wooded along the streams, leaving about one-third of the township in prairie. Magnetic variation, 8° 40' to 10°.

Rochester.—(T. 106 N., 14 W.) The township is mostly brushy, with scattering timber. Bluffs accompany the streams. Several marshes are laid down. Magnetic variation, 8° 15' to 9° 50'.

Salem.—(T. 106 N., 15 W.) Two marshes of about 120 acres each, and one of about 160 acres are given. About two-thirds are marked as wooded, but the prairie portion comes at the north, where the streams are most abundant. The streams are not marked as bluffy. Magnetic variation, 8° 47' to 9° 38'.

Elmira.—(T. 105, N. 11 W.) This township was about half-wooded. An independent drainage is marked in sections 8, 9, 16, 17. Bluffy mounds not on streams are marked. Magnetic variation, 8° 45' to 10° 55'.

Orion (T. 105 N., 12 W.) is somewhat wooded along streams. In sections 10 and 15 a stream is represented as sinking. The banks of Root river are bluffy. A small lake is given in sections 35 and 36. Magnetic variation 9° 20' to 12° 12'.

Pleasant Grove.—(T. 105 N., 13 W.) A large marsh of about 120 acres is laid down in the southern part of the township. A band of woods about 3 miles wide accompanies the river, the banks of which are bluffy. Magnetic variation 8° 25' to 10° 57'.

High Forest.—(T. 105 N., 14 W., with a range of sections in T. 104 N., 14 W.) A large marsh—about 320 acres—is laid down in sections 30 and 31. The township is wooded along the streams, but is about half prairie. Magnetic variation 6° 45' to 9° 55'.

Rock Dell.—(T. 105 N., 15 W., with a range of sections in T. 104 N., 15 W.) A large marsh—320 acres—in the northwestern part. The land along the streams is little wooded. The banks of the streams in the northern part are bluffy; in the southern, not. Magnetic variation 7° 40' to 9° 18'.

There seems to be no easily recognizable order in the magnetic variation for different parts of the county. The extremes were 6° 45' and 12° 12', in High Forest and Orion respectively. Both these towns are on the south side and not far apart.

Some *elevations* have been taken on lines of railroad, built or proposed, through the county. Those of the Winona and St. Peter R. R. I have not been able to see. Mr. W. D. Hurlbut tells me that the survey for this railroad makes Eyota 1,210 feet above the sea, and gives the same height (1,210 feet) to Byron.

The following are elevations on the line of a proposed railroad from Wabasha to Austin, and along the lines of several other pro-

posed roads. Some of them fall in neighboring counties, but they are given here to make them of general use. They are from the notes of Horace Horton, civil engineer, Rochester, who ran the lines on which the elevations occur. These elevations were referred to the level of low water in the Mississippi River at Wabasha. This is 30 feet below St. Paul and 620 feet above the surface of the ocean.

ELEVATIONS FROM THE NOTES OF HORACE HORTON, C. E.

	Above the Mississippi River at low water at Wabasha.	Above the Ocean.
1 Head of East Indian creek, 5 miles N. E. of Plainview, (Wabasha county.)	534	1,154
2 Street of Plainview (Wabasha county.)	518	1,138
3 Elgin, (Wabasha county.)	390	1,010
4 Near center of sec. 14, Haverhill	634	1,254
5 S. W. corner sec. 24, Haverhill, (Rock, seen some feet above.)	570	1,190
6 Base of Sugar Loaf, sec. 31 and 32, Haverhill	390	1,010
7 College street bridge, Rochester	340	960
8 Surface of water beneath	325	945
9 Summit of Lone Mound, section 11, Farmington, within 10 feet of Plainview level, viz.:	518	1,138
10 S. E. corner sec. 10, High Forest	667	1,287
11 Low water at High Forest village	570	1,190
12 Sec. 29, T. 104 N., 15 W., Mower Co., half mile south John Rowley's house	757	1,377
13 Dr. Thornhill's farm, 4 miles east Brownsdale, in Mower county	730	1,350
14 S. Minn. R. R. at Brownsdale, (Mower county.)	632	1,252
15 St. Paul and Milwaukee R. R. track at Austin, (Mower county.)	560	1,180
16 Chatfield, about	267	887
17 Pleasant Grove, about	667	1,287
18 Creek near the schoolhouse in sec. 15, Cascade, about	365	985
19 N. W. corner section 10, Cascade	500	1,120
20 Quarter stake, sections 33 and 34, Oronoco	490	1,110
21 Center stake, sec. 21, Oronoco	465	1,085
22 Surface of river at Oronoco	315	935

Lone Mound (elevation 9) is about 150 feet above the surrounding country.

Elevation 10 gives the summit of the water-shed between the Zumbro and Root Rivers. From section 5, Orion, to section 21, Rock Dell, the elevation of this water-shed does not vary 10 feet from the figures given. By comparing the figures in the table it will be seen that this water shed includes the highest land in the county of which we have any record of observations. A general elevation toward the south and southwest is visible. This elevation

reaches its maximum in the counties south, which include in t borders the most elevated land in the State. On comparing geological map of the county, accompanying this report, and table of elevations, a striking relation between the altitude and ological formation is rendered manifest. This will be more par ularly referred to under the heads of the individual formations.

Timber.—Heavy timber is found along the large streams, tho it is pretty well cut out now. Aspen and brush thickets are co mon everywhere. The following trees, shrubs and twining pla were observed while driving through the county:

I. *Trees.*

Basswood (*Tilia Americana. L.*)
Sugar Maple (*Acer Saccharinum. Wang.*)
Red Maple (*A, rubrum. L.*)
Soft Maple (*A, dasycarpum. Ehr.*)

The first two maples do not usually attain any considerable size, w the soft maple, in a state of nature, becomes a large tree.

Box Elder (*Negundo aceroides. Mœnch.*)

This tree is common along streams and is a favorite in cultivation. transplanting it is trimmed up too much to easily take root. It is a pr tree, of pleasing form and full foliage.

White Ash (*Fraxinus Americana. L.*)
Slippery Elm (*Ulmus fulva. Michx.*)
Corky Elm (*U. racemosa. Thomas.*)

Of which I saw several trees along the streets in Rochester. It was doubtedly transplanted from woods close by.

White Elm (*U. Americana. L. pl. Clayt. Willd.*)
Black Walnut (*Juglans nigra. L.*)

A grove of these trees was seen in Kalmar.

Butternut (*Juglans cinerea. L.*)
Hickory (*Carya.*)

Only very small trees were seen. It is said that they are always when young to make round barrel-hoops, such hoops having been to to be characteristic of barrels containing Minnesota flour. It is a dest tive and pernicious practice, for thus one of the most valuable of tre prevented from maturing. The only way to prevent it is to make sq hoops the fashion for Minnesota, which could easily be done by a co nation of the leading millers.

Bur-oak, (*Quercus macrocarpa. Michx.*)

Is very abundant. On prairies it is low, 3–8 ft. high, forming exten thickets and fruiting abundantly. In more favorable localities it is la and may become quite a tree.

White-oak (*Q. alba. L.*)

Is hard to distinguish at a distance from the preceding. Undou specimens were seen near High Forest.

Jack-oak, Yellow-oak, etc., etc., (*Q. coccinea, Wang. Var. tinctor*

Like all the species of this group of oaks, this tree is hard to iden It is very common but is gradually disappearing before civilization. frequently seen dead or dying, without apparent cause.

Paper-birch (*Betula papyracea. Ait.*)

Small, along streams in the northern part of the county.

American Aspen (*Papulus tremuloides. Michx.*)

Very common, usually small.

Coarsely toothed Aspen (*P. grandidentata. Michx.*)
Cottonwood (*P. monilifera. Ait.*)

A great favorite in cultivation.

Balm of Gilead (*P. balsamifera. L.*)
Silver Poplar (*P. alba. L.*)
Lombardy Poplar (*P. dilatata. Ait.*)

The last three are introduced and are very common in cultivation.

Willows. Several species were seen, some of them becoming large trees.

White Pine (*Pinus strobus. L.*)

A few straggling specimens were seen on the bluffs three miles east of Rochester.

Locust (*Robinia Pseud-acacia. L.*)

Is commonly cultivated. The same is true of several pines and spruces, and a larch.

II. *Shrubs.*

Prickly Ash (*Zanthoxylum Americanum. Mill.*)
Smooth Sumac (*Rhus glabra. L.*)
Poison Ivy (*R. Toxicodendron. L.*)
False Indigo (*Amorpha fruticosa. L.*)
Lead Plant (*A. Canescens. Nutt.*)
Wild Plum (*Prunus Americana. Marshall.*)

Apparently several varieties, some of them producing the greatest abundance of pleasant fruit.

Wild Red Cherry (*P. Pennsylvanica. L.*)
Choke Cherry (*P. Virginiana. L.*)
Wild Black Cherry (*P. serotina. Ehr.*)
Nine Bark (*Spiraea opulifolia. L.*)
Common Meadow-Sweet (*Salicifolia. L.*)
Wild Rose (*Rosa blanda. Ait.*)
Wild Red Raspberry (*Rubus strigosus. Michx.*)
Wild Black Raspberry (*R. occidentalis. L.*)

Flavor of the fruit is said to be remarkably good.

Common Blackberry (*R. villosus. Ait.*) Not common.
Black Torn (*Cratægus tomentosa. L. Var. pyrifolia.*)
Black Thorn (*Cratægus tomentosa. L. Var. punctata.*)
Choke-berry (*Pyrus arbutifolia. L.*)
Am. Mountain Ash (*P. Americana. DC.*) Cultivated.
Eu. Mountain-Ash (*P. Aucuparia. Gært.*) Cultivated.
Red-osier Dogwood (*Cornus stolonifera. Michx.*)
Panicled Dogwood (*C. paniculata. L'Her.*)
Wolf-berry (*Symphoricarpus occidentalis. R. Br.*)
Sheep-berry, Wild Haw (*Viburnum Lentago. L.*)
Cranberry-tree (*V. Opulus. L.*)

Is frequently cultivated.

Hazel (*Corylus Americana. Watt.*)

Abundant on prairies.

Low Birch (*Betula pumila. L.*) Cold bogs.
Speckled Alder (*Alnus incana. Willd.*) Along streams.
Juniper (*Juniperus Sabina. L.*)

Seen only on a rocky bank on Root River—sec. 35. Rock Dell.

III. *Vines.*

Virgin's Bower (*Clametis Virginiana. L.*)
Frost Grape (*Vitis cordifolia. Michx.*)
Virginia-Creeper (*Ampelopsis quinquefolia. Michx.*)

Common wild and a favorite in cultivation. It is often erroneously called *Ivy.*

Shrubby Bitter-sweet (*Celastrus scandens. L.*)
Hop. (*Humulus Lupulus. L.*)

Wild and in cultivation.

THE GEOLOGICAL STRUCTURE.

The outcrops of rock are numerous throughout the county. It lies just at the edge of the system of deeply eroded valleys extending westward from the Mississippi. To the east of it are the deep ravines which cut through the high bluffs at the base of which the

great river lies. The beds of these ravines gradually rise in receding from the Mississippi, and it is in Olmsted county that they rise to near the surface of the surrounding country. To the west and southwest of the county lies the great accumulation of drift which grows deeper and deeper as one passes westward. This material thins out over Olmsted. In the southwest corner it is thick enough to conceal entirely the rock-features below. Eastward it appears only in thin outliers, marking the ragged edge of deposition, or in patches and masses which are remnants left by subsequent erosion. In order to see to the best advantage the changes in the drift, features of erosion, and stratification, one must cross the county obliquely. There is the least drift, generally speaking, in the northeast corner, and the most in the southwest corner. On the other hand, the southeast and northwest corners are much alike in the very feature in which the other two corners differ. In a rough way the lines of change cross the county diagonally in a southeasterly and northwesterly direction. This is due to two facts which may have some relation with each other. In the first place the Great River in the vicinity of the county runs in a generally southeast direction. The erosion-valleys extending from it would tend to take a direction perpendicular to it, and the lines of equal depth of erosion would tend to be parallel to it. Again, the dip of the rocks in this county is slightly southwest. The edges of the strata as presented on the surface would tend to be in lines perpendicular to this direction.

There are no signs of noteworthy upheaval, depression or other changes in the relations of the strata to each other in this county, as in the whole of this part of the state the strata are conformable. The peculiar structure of the bluffs enables one to trace some of the strata at a distance. As far as the eye can follow them their planes occupy the same position with reference to the horizon. The only exception to this is the Cretaceous. Its rather doubtful patches in the county lie in nearly a horizontal plane, and across the edges of the strata below.

The strata of the rocks other than Cretaceous do not lie in a horizontal plane. The dip is very slight, and in this county is toward the southwest. Toward the northwest corner the line of dip alters a little, and is more southerly. Comparison of altitudes and strata over a larger portion of the State has convinced Mr. W. D. Hurlbut that the dip here is 10 feet to the mile southwest. All my observations in the county tended to prove the correctness of this estimate.

The stratigraphy of this fine county is easy to read in most cases. The form of the bluffs, the line of springs making a definite part of the Trenton, the differing solubility of the rock and the consequent occurrence of sink holes, caves, etc., in one formation and not in another, the lithological character of the rocks notably distinct in some of the formations, and the gradual and regular dip of the strata, which, when taken with the erosion, enables one to predict with much certainty the rock over which he is standing, even when it is hidden from view—all these enable one to read the stratigraphical enigma of the county with little trouble. In this

study the intimate knowledge of the county possessed by Mr. Hurlbut assisted me greatly. He cheerfully rendered me all the assistance in his power, besides hospitably entertaining me at his house. The stormy weather of the season devoted to this work prevented me from visiting all of the county. In such cases the details of the map accompanying this report were put in by Mr. Hurlbut. You yourself, sir, as director of the survey, have frequently passed through this county, and your observations in it have not only confirmed many of my own, but have added facts which escaped my attention.

I will here embrace the opportunity of recommending Olmsted county as an excellent field for teaching stratigraphy. The strata are interesting, the characters mentioned above make the reading of them easy, the scenery is unusually attractive. I can conceive of no better spot to which to take a class of students for instruction in geological field-work.

The formations found in the county are not numerous. The Potsdam sandstone is said to be found in the beds of the Zumbro and Whitewater rivers, about where they leave the county. It has not been seen by me, however, and the sandstone is probably only one of the lower sandstone layers of the Lower Magnesian. The latter formation, the St. Peter sandstone, the Trenton limestone and the Galena, are found here, the first and last probably only represented by a part of their entire thickness. A little Cretaceous was found.

THE LOWER MAGNESIAN LIMESTONE.

The AREA of this formation in the county is as follows. It follows the larger streams, beginning on them when well in the county, and broadening out until it leaves the county with them. It appears in the beds of the branches of the Zumbro well up in Rochester, Marion, Haverhill and Cascade townships. Rochester lies on a floor formed by the upper surface of this formation. The valley of Rochester city is entirely shut in by bluffs, except where the Zumbro passes out to the north and along a geological valley, now dry, to the northwest. This lower magnesian valley of Rochester city is somewhat crab-shaped, and is formed by the meeting of the various streams which make up this branch of the Zumbro. Cascade township is about half Lower Magnesian, the remaining surface being occupied by spurs and islands of the formations above, one of these islands being quite large. Oronoco township is almost exclusively Lower Magnesian. Farmington is of the Lower Magnesian floor, except the southern edge and some outliers of Trenton and St. Peter. In New Haven the middle fork of the Zumbro soon rises to the Trenton, while the north fork lies on the Magnesian, until it passes into the next county west. A large portion of Quincy is Lower Magnesian, as is a little of the northeast of Viola. An arm of this formation appears at the surface in the bed of the river, passing nearly through Dover from east to west. Elmira is also floored with Lower Magnesian for the most part, as is a small portion of Orion. The village of Dover lies in a Lower

Magnesian valley, something like that of Rochester city. The same is true of Chatfield. Something more than 20 per cent. of the county has a floor of Lower Magnesian.

The *Lithological characters* of the formation here partake of its general characters in Minnesota as described by the Director of the Survey in his First Annual Report (for 1872, pp. 81–83.) It varies from a compact, fine magnesian limestone to a pure, friable, saccharine white sandstone. It is frequently in irregular layers, which are not continuous for any distance. Sometimes these layers are thin and continuous; sometimes they are thick and cleave naturally into massive blocks. The rock is often brecciated, occasionally massive. Broken cherty layers, irregular silicious pockets, mottled sandstone, oolitic limestone, vesicular limestone, sparry cavities of considerable size, are all found in this variable yet usually easily recognized rock.

This rock holds its form well and thus produces characteristic *surface features*. When worn deeply into by erosion it presents bold cliffs and craggy, rounded hills. When not covered thickly by drift, it makes a poor surface for agriculture, as may be seen in some parts of Oronoco. It is nearly barren, and is covered with scant grass, with hazel and scrub oak (in this case dwarf *Quercus macrocarpa*) or with small paper birch, and other wood-growth not large enough to be of importance economically. When this floor is covered by drift, as in the beautiful prairie township of Farmington, the soil may be unsurpassed. The most of this township is devoted to wheat, and at the proper season it seems to be one continuous wheatfield.

A *section* of this formation is seen at Quincy Mills. It is described in the First Annual Report, (for 1872) p. 82, and need not be repeated.*

The following section was taken at the lime-kiln of James Barnett, on section 8, Oronoco, just northeast of the village:

* *Note.*—As the report for 1872 is entirely out of print, the section at Quincy is hereby appended, in order to complete the geology of the county. No. 1 of this section is of the Shakopee limestone, and No. 2 is the upper portion of the Jordan sandstone.—N. H. W.

Descending Section at Quincy, Olmsted County.

No. 1. Dolomitic limestone; quite arenaceous, falling out in huge masses which are rough, distorted in their crude bedding, and unmanageable as a quarry-stone, showing much calc-spar. Limestone and sandstone are mingled with occasional strips of light-green shale. In general the face presents the appearance of an alternation of horizontal layers of thin and more shaly beds, with heavy, coarse and rough limestone beds. Some green shale layers alternate with dark, umber-colored (ochreous) shale, neither being more than two inches thick. They are tortuous and not continuous. This phase appears like the tops of the bluffs at Winona, but is probably at a considerably higher horizon..... 30

No. 2. Persistent, white sandstone, or granular quartzite, seen.... 10

Total exposure..... 40

alciferous sandstone, much broken, in thin layers, buff	14 ft.
ompact little broken calciferous sandstone, light buff	2 ft.
andstone (mostly saccharine) in layers	4 ft. 3 in.
luminous limestone, in thin layers, light buff	1 ft. 7 in.
ark sandstone with numerous blue spots	1 ft. 8 in.
renaceous vesicular dolomite	3 ft. 6 in.
ke second above	4 ft.
ke second above, but more irregularly bedded	1 ft.
esicular, sparry, irregularly bedded dolomite	4 ft.
Total as far as seen	37 ft. 8 in.

he above section begins at the top. No fossils could be found. e lowest layer (last described) is employed by Mr. Barnett for ing lime. The lime is light buff, slow, and contains considera- cement.

his lime is of considerable *economical value*. The lime of Bar- is good notwithstanding its slowness, and the cement in it only reases its value for many purposes. Mr. Barnett uses 12 cords wood to one charge of his kiln. The wood costs $2.00 per cord. e kiln burns three days and affords 120 barrels of lime. Mr. rnett says that the lime is slow in slacking, but that it sets quickly. his rock does not furnish much good building material in this nty. It is not of even bedding and homogeneous, texture gen- lly. Pieces are sometimes employed at Rochester for window-caps d water-tables. These pieces are found only in the uppermost ers. No general use is made of them.

THE ST. PETER SANDSTONE.

he *area* of this rock is difficult to represent on a map. It is so able that it will not endure erosion when left to itself. It is only en it is capped by the lower layers of the Trenton that it suc- sfully resists the attacks of water. By itself, uncovered by other mations, it occupies but little space. It juts out beneath the cap limestone only a few feet or rods. From a projecting spur of estone it may extend farther, as is illustrated in the city of chester. A spur of Trenton comes in from the west and ends ar the city limits. The sandstone, however, can be struck in king wells almost anywhere in the western portion of the city. casionally where erosion was incomplete an outlier of crumbling dstone can be seen, not capped by limestone. Such an outlier y be found in or near SW. Farmington. This must happen but ely, and the outliers can attain but small size. Streams of con- erable size usually leap from the Trenton to the Lower Magnesian, intervening St. Peter sandstone having been washed completely ay at an early period. Sometimes, however, streams of small remain in a bed of St. Peter sandstone, in which case the val- is sandy, covered with small oaks, and worth little for agricul- e. This is seen in the valleys of Bear Creek and its branches.

he *surface features* caused by the presence of this sandstone are resting, and have already been referred to. As the incoherency this formation deprives it of the power of resisting erosive

forces, it is usually carried away cleanly wherever exposed. The consequence is a precipitous descent from the Trenton to the Lower Magnesian. This appears in lines of remarkable, level bluffs. The height of these bluffs is usually the thickness of the formation with fifteen or more feet of limestone on the top. These bluffs are especially noticeable around Rochester. To the east their top is reached by a rugged ascent, to the west by gradual dip of the strata. The erosive forces have left many small and isolated bluffs which can be properly described under this head, though the lower layers of Trenton limestone assist in their formation. They appear as rugged mounds rising from the Magnesian floor, and form a striking feature in the aspect of the neighborhood. They are most abundant in southwest Farmington and in Elmira. A few are seen along the railroad, just east of Rochester. Perhaps the most remarkable is "sugar-loaf mound," about two miles east of the city and close to the railroad. Its shape and relative proportions are those of a sugar-loaf. Another remarkable one is "Lone Mound," of section 11, Farmington. It is about three miles from the line of bluffs south. Two or three miles northwest are two similar mounds, called "Twin Mounds." They are in Wabasha county.

The thickness of the St. Peter was ascertained with an aneroid barometer, near Rochester. The upper layers of the Lower Magnesian were found on Bear Creek, near the woolen mills. The upper surface of the St. Peter was ascertained as carefully as might be near Whitcomb's quarry, and near Jenkins' quarry. Three comparisons were made. The proper allowance having been made for dip and atmospheric change, the value of 111 feet was obtained for the thickness of this formation.

The *lithological character* of the St. Peter is uniform and simple. It is a rather coarse, white, friable sandstone, pure white, except where contaminated by foreign substances or percolations from the formation above. It contains no fossils so far as I could see in this county.

This formation is *useful* in several ways. When with a tight magnesian floor, it holds water, and furnishes a good supply to wells. It is sometimes excavated where it comes out on the face of a bluff. Excellent cellars, dry and of uniform temperature, are thus formed which are used especially for the preservation of vegetables. It supplies an inexhaustible amount of pure white sand round-angular, and excellent for mortar or glass-making.

THE TRENTON LIMESTONE.

As this formation lies next above the St. Peter, and as the dip is southwest, we should expect to find it just behind the sandstone. Such is the case, but being a coherent limestone it occupies much more *area* than the St. Peter. It covers fully one-half of the county stretching in a broad, interrupted band from southeast to northwest. Its outer edge is the labyrinthine, interrupted line of level, peculiar bluffs which reach in their serpentine course every township in the

county, except only Rock Dell and High Forest. The southwestern or upper edge of its outcrop can not be traced so minutely, as this formation passes insensibly into the Galena which overlies it. The formation covers the most of Kalmar, Haverhill, Viola and Eyota townships. It caps also with a few feet of limestone the most of the outliers of St. Peter already mentioned.

The *lithological characters* are described in the First Annual Report (already referred to) and need not be repeated.

In general, as seen in this county, we have, below, a shaly limestone, often presenting beds of blue limestone useful for building. This is more or less interrupted by shale and averages 15 feet thick. Above this is a bed of green shale more or less interrupted with limestone, and about 15 feet thick also. Above this we have 125 feet of yellow, or gray, harsh, magnesian limestone, in regular beds of varying thickness. In deep quarrying this rock also is blue.

Many sections of this rock can be seen. It is the rock most generally quarried. Several sections for Olmsted county are given on pp. 97–99 of the First Annual Report of the survey (for 1872.) The characters of others examined by me were uniform with those there described.

Many fossils are found in these beds. *Chaetetes Lycoperdon* is plentiful in the green shale. *Leptaena*, *Orthis*, *Strophomena*, *Murchisonia*, *Pleurotomaria*, *Orthoceras* are common. The orthoceratites are unusually large.

This stone is the one most used in this county for building purposes. The stone for the buildings about Rochester were for the most part taken from the Trenton quarries near by. The quarry of W. Jenkins, just within the city limits, furnishes a large proportion of this stone.

It has been suggested that the clay of the green shale would make good brick or pottery. The grain is very fine, but the presence of small, calcareous fossils injures it for these purposes. A pottery factory, in which this clay was employed, started some years ago, had to be abandoned on this account.

THE GALENA LIMESTONE.

The *area* of this formation in the county is much less than that of the Trenton. It is found only in the southwestern part of the county, and covers rather less than 20 per cent. of the whole area. Byron, in Kalmar, is located on this rock. It underlies nearly all of Salem and High Forest, and considerable parts of Rock Dell, Rochester and Pleasant Grove. It extends into Marion and Orion, and Mr. Hurlbut tells me that a small scalp of it may yet be found in the western part of Eyota township. The lower and upper edges of its outcrop can not be accurately traced. In the case of the lower edge it is for the reason already mentioned, viz.: the Trenton and Galena blend gradually. The upper edge cannot be traced because it is completely concealed by drift.

In *lithological character*, as seen here, this rock is a heavily bedded, buff dolomite, fine grained, or coarse and porous. It contains often

appearance of the bluffs formed by the Galena.

This limestone is well displayed in this county at Garrick's quarry, Sec. 17, Rochester township. The floor of this quarry is about 30 feet above the Trenton. To the top of the quarry is about 35 feet. The rock is a sparry, magnesian and more or less arenaceous limestone. It is in beds one to three feet thick, separated by very thin layers of light blue shale. The beds are massive and yellowish, somewhat stained with iron, arising from the decay of iron pyrites. The upper portions are most arenaceous and fossiliferous. In the crevices is found abundance of satin spar, and in the largest ones stalactites may be found.

R. Williams' quarry, on the north bank of Root river, Sec. 31, High Forest township, is in this formation. This rock is exposed for 25 feet, and is dolomitic, more or less concretionary, with small, spar-lined cavities. It is sparingly fossiliferous. The upper six feet are much broken up. The remainder is compact and unevenly bedded. The concretionary structure is not visible on fresh surfaces. It is brought out by weathering and especially by burning, and then appears in the form of fine rusty lines.

On the left bank of the same stream, about one mile west of Williams' quarry, is an exposure of yellow thin-bedded, broken, uneven, dolomitic limestone, of which only 8 or ten feet are visible. I found no fossils, but was sure, from the lithological characters, that the rock is Galena.

The same rock is well exposed in the ravines of Salem and Rock Dell, where it is quarried to some extent for building.

As to *economical value*, this formation produces the best building stone found in the State. It is much used in Rochester, but has been mostly derived from Mantorville, in Dodge county. It will be further described under that head. At Russell Williams' quarry, near High Forest, it is burned for lime. There are five kilns at this place. Each kiln takes 12 cords of wood for one charge of stone. The wood has to be brought from a distance, and costs at the kiln $6.00 per cord. Three hundred barrels of lime are burned in a kiln. The lime is white and fine, and has the best reputation of any lime hereabouts. It sells at $1.00 per barrel.

THE CRETACEOUS.

A careful search along Root River and elsewhere in the southwest corner of the county, failed to afford me the slightest trace of

the Maquoketa shales, which would be naturally expected overlying the Galena. An outcrop was found a few rods west of P. Brewer's residence, in the southwest quarter of section 35, of Rock Dell township, on the north bank of Root River, the character of which is doubtful. The formations in the adjoining counties, and the lithological character, indicate the probability of its being Cretaceous, and it is thus marked on the accompanying map. The exposure is along a road-track going down to a ford of the stream, and was partially covered with soil and overgrown by bushes. The following is the section from below upwards:

Compact, blueish limestone	2 feet.
Indurated, arenaceous, yellowish shale	1 foot.
Yellow sandstone, in broken layers	1 foot.
Light blue clay	½ foot.
Reddish, broken sandstone	1½ feet.
Light blue clay	¼ foot.
Sandstone	1 foot.
Sandy, bluish clay	½ foot.
Total seen distinctly	7¾ feet.

The same arrangement of alternating sandstone and clay could be traced indistinctly four or five feet farther up.

Three rods farther down the river is a compact limestone, siliceous, not dolomitic, non-fossiliferous, much broken by frost. The line of meeting of this with the preceding was concealed by soil and overgrowing plants.

The first described is in all probability Cretaceous; the second I am unable to refer to any formation with certainty. Perhaps it is Cretaceous, perhaps Niagara.

A scalp of Cretaceous, containing fossils in abundance, is said to have been found in the western part of Eyota township. It was of very limited extent.

THE DRIFT.

This covers much of the county. It thins out toward the northeast. It is of considerable thickness in the southwest. Its edge is ragged and shows extensions, which, however, are not in conformation with the present drainage system. It consists of blue clay, washed or yellow clay, stratified gravel and sand, and boulders.

The blue clay is by no means continuous. It is found in limited areas, and bands in various parts of the county. Sometimes it forms distinct ridges, as in western Rochester city and in the valley directly east of Rochester. In such cases it usually abuts on a bluff.

The washed clay, as its name indicates, has been worked over by water since its deposition in the drift. It occupies low pond-like spots, or abuts on the bluffs. It is usually of a uniform reddish-yellow color and quite arenaceous. Sometimes it is in colored layers of red, yellow and green. In this case its derivation is probably from the green shale of the Trenton as well as from the drift. The washed clay is used for bricks.

The exposures of sand and gravel are not extensive in the parts of the county examined by me. Where seen they exhibit the usual characters. The boulders are entirely absent in most parts of the county. In many scattered localities, again, they are abundant; and in the southwest corner of the county they are often found of great size.

The following table of wells will be useful for an analysis of the drift. The facts were furnished by O. Sprague, practical well-digger. Mr. Sprague is an observing man, and has probably dug more wells than any one else in the county:

Wells in Olmsted County.

O. SPRAGUE.

Location.	Owner.	DEPTH IN FEET			Water.	Remarks.
		Drift.	Rock.	Total.		
35. Farmington ...	C. E. Stacy.	22	31	53	Good.	5 feet black soil; then reached clay.
35. Farmington....	W. H. White.	20	24	44	Good.	Yellow clay and blue rock.
36. Farmington....	E. Raymond.	11	..	11	Good.	Blue clay.
25. Farmington....	W. Searles.	44	..	44	Good.	14 feet black heavy soil; remainder blue clay.
30. Haverhill	J. P. Simonds.	25	10	35	Soft.	25 feet sand; 10 feet hard sand rock.
9. Haverhill	P. H. McGovern.	40	50	90	Good.	Red, hard drift.
33. Haverhill	J. E. Brown.	25	..	25	Good.	4–5 feet soil, then sand.
11. Haverhill	B. F. Bulen.	12	..	12	Plenty.	Red, hard drift.
14. Salem.....	Z. Holt.	25	..	25	Good.	Sand all the way.
14. Salem.....	J. D. Fuller.	40	..	40	Good.	Sand all the way.
26. Salem.....	J. P. Fosdick.	30	6	36	Soft.	White, hard rock.
21. Salem.....	Ole Severson.	27	..	27	Good.	Sand.
16. Salem	C. Peterson.	25	..	25	Good.	Sand.
16. Salem	Nils Jacobson.	25	.	25	Good.	Sand, foot of bluff.
16. Salem.....	T. Thomson.....	57	16	73	Good	Red, hard drift; white limeston e.
28. Salem.....		32	..	32	Good.	20 feet blue clay.
30. Pleasant Grove.	Fred. Sibeck.	61	..	61	Good.	48 feet blue clay.
29. Pleasant Grove.	J. Collins.	21	..	21	Good.	15 feet blue clay.
25. Pleasant Grove.	D. W. Hymes.	20	40	60	Good.	Sandy, red clay.
11. Cascade.....	T. C. Cumings.	30	..	30	Plenty	25 feet blue clay.
17. Cascade.....	J. H. Hodgman.	25	..	25	Plenty.	Sand.
17. Cascade.....	E. Babcock.	25	..	25	Plenty.	Sand.
15. Cascade . ..	P. Boardman.	30	..	30	Plenty.	Red, sandy clay.
15. Cascade.....	J. Gardner	30	..	30	Plenty.	Red, sandy clay.
15. Rochester.....	I. M. Westfall.	40	..	40	Plenty.	Sand.
2. Rochester.....	W. L. Brackenridg	18	..	18	Plenty.	Sand.
5. Viola.....	D. D. Whipple.	44	50	94	Plenty.	

Cedar logs at considerable depths in the drift are found but rarely. Mr. Sprague says they are always under the blue clay. Rotten wood is occasionally found in the blue clay.

It is a striking fact, often mentioned, that water is often found on the bluffs at a much less depth than at their base. The geological formation satisfactorily accounts for this.

Brick are made at many places in the county. Oronoco, Eyota, Pleasant Grove and Byron furnish brick. The most of them are made at Rochester. E. P. Brown burns 350,000 a year. Whitcomb Bros. burn, as they tell me, 1,200,000 brick per year, in five or six kilns. The brick here and at Brown's are machine made. V. Whitcomb has a small brickyard near that of Whitcomb Bros.

ll cases coming under my observation the brick are made from washed clay. This is in beds from two feet to ten or twelve or more. Although this material is sandy, more sand is usuput in in making the brick, which are consequently tender, of poor quality. The brick vitrify but little when burned.

› peat was observed in the county. In some lowlands the turf ick and comparatively free from inorganic matter. This will and produce some heat, but it is much inferior to proper peat. v no peat-bogs nor any extensive accumulations of peat-prong plants of any kind in the county.

›LD has been found in the drift along the Zumbro from Rochesnd Oronoco down to the Wabasha border and beyond. It is d only on the Lower Magnesian. Murchison calls attention to fact as generally true. It is found in the drift about the stream, nostly in the bed of the stream or in material worked over by a comparatively recent date. In the same alluvial material is d a small amount of black sand, of a specific gravity approachhat of gold. When the gold is obtained by washing, after all ›ther materials are washed away this heavy black sand remains, the minute fragments of gold are picked out from it. It is ›fore here called the " mother of gold," and the two are thought e always together, a conclusion which need not necessarily w.

ıe gold is in minute, angular fragments. The quantity is so l that it does not pay to work it by the ordinary method of -washing. Washing on a more extensive scale might be made ıy. It has been tried two or three times, but never under fable circumstances, or for periods of any length. It remains o be seen whether it will pay or not.

may be worth while just here to call attention to the fact that is frequently found under these circumstances. It has been l over extensive regions in Canada, where attempts at obtaint on a large scale have always failed to pay. I have heard of Vermont, Ohio, Wisconsin and Iowa. The Director of the ›gical survey reports it from several places in Minnesota bethis, i. e., in Fillmore county, at Jordan, in Scott county, etc., From all these facts the conclusion may be drawn that the ›ects of its paying in Olmsted county are not good.

This county lies immediately wes
is that of a rectangle. It is a smal
in a north and south direction, and
area is as follows. This table is tal
Auditor, Hon. O. P. Whitcomb:

AREA OF DODG

Name of Township.	T
Vernon	
Canisteo	
Mantorville	
Milton	
Hayfield	
Ashland	
Wasioia	

of these branches is the South Branch of the Middle Fork of the Zumbro, which rises in Rice Lake, on the western border of the county, and flows eastward through nearly the central portion. The north branch of the same stream has its source in the wet prairies in the northwest corner of the county and flows nearly eastward also. The south fork of the Zumbro reaches this county by two small branches which have their sources in the southeastern part. Cedar River enters near the southwestern angle of the county. It drains Westfield and a part of Hayfield. The fall of the streams is inconsiderable in all parts of the county, but is greater in the northern part of the county than in the southern.

Rice Lake lies partly in this county, partly in the county next west.

Water Powers.—Two streams only furnish them in this county. These are two branches of the Zumbro, both branches of middle fork. The following is the list of these powers:

Mills.	Owner.	Location.	Stream.	Head Feet.	Stone. Run.	Kind of Mill.
Wasioja.....	A. Mason & Son..	Wasioja Village	Middle Fork.	9	4	Cus. & flour.
Blake's.....	J. D. Blake.....	Sec. 13, Wasioja	Middle Fork.	12	4	Flouring.
Mantorville..	Adams & Kneeland	Mantorville Vill	Middle Fork.	10 / 7	3	Custom.
Rockton.....	John Bradford.....	22, Mantorville.	Middle Fork.	8	2	Cus. & flour.
Agawam.....	Chase & Swaringan	13, Mantorville.	Middle Fork.	12	2	Flouring.
Eagle Valley.	J. Gordon.....	15, Concord ...	North Fork..	12	2	Custom.
Buchanan ...	Widow Irish.	Buchanan Vill..	North Fork..	10	...	Saw mill.
Milton.....	James Elias.....	9, Milton	North Fork..	8	2	Custom.

Of the above mills that at Mantorville has two powers, one about 110 rods below the other. Agawam Mills is the latest name for what has been called Dodge County Mills and Bunker's Mill. An unimproved mill-privilege was found at Concord. The Middle Fork of the Zumbro rises in Rice Lake. This lake also has a natural outlet toward Straight River on the west.

In order to give the mills just enumerated on the Middle Fork as much water as possible the western outlet to the lake has been cut off. Yet for three or four months in the winter of 1874–5 the mills had no water. Some years, however, they continue to have water the year through. The water in the North Branch is even more unreliable than this.

The *surface* is but little diversified. The southern and southwestern part of the county is prairie-land. In the northeastern portion bluffs of some hight are found along the streams. The southwestern part of the county is marshy and thinly settled. The region around Rice Lake is also low and marshy.

The plats of the government surveys were examined in the office of the county register and the following notes were made:

Vernon (105, 16) contains considerable grub-land and a small thicket. The remainder is all prairie. The magnetic variation is from 8° 20′ to 9° 06′.

Canisteo.—(106, 16.) A few acres of marsh and a small pond are

found in this township. About two-ninths of the township is set down as brush land. The remainder is prairie. Magnetic variation, 8° 26′ to 9° 0′.

Mantorville.—(107, 16.) This township has a small marsh laid down about 40 acres in extent. A considerable portion of the township is pretty heavily wooded, especially along the streams. Magnetic variation, 7° 24′ to 9° 10′.

Milton.—(108, 16.) A small marsh of 25 acres is platted. The northern half is mostly wooded. The southeastern part is wooded, and isolated groves are found on the remainder. On the portions marked prairie are often found notes of "barren thickets," "barrens," "scattering timber," &c. Magnetic variation, 6° 45′ to 10° 0′.

Hayfield.—(105, 17.) It is but little wooded, only about 16 per cent. The remainder is prairie. Magnetic variation, 7° 40′ to 8° 55′.

Ashland.—(106, 17.) A pond of about 10 acres is found on the eastern line of section 25. About one-ninth of the township is wooded. Magnetic variation, 7° 55′ to 8° 50′.

Wasioja.—(107, 17.) A small marsh of about 160 acres is laid down in sections 8 and 9; also a patch of wet land of 240 acres in the western part of the township. Wood follows the main stream, and a few scattering patches are found elsewhere. The remainder is prairie. Magnetic variation, 7° 22′ to 8° 30′.

Concord.—(108, 17.) Eight small marshes varying from 8 to 40 acres are platted. Some woods but mostly open. Magnetic variation, 6° 25′ to 8° 47′.

Westfield.—(105, 18.) Three marshes from 50 to 320 acres each are recorded. A little wooded land is also present. The remainder is prairie. Magnetic variation, 7° 24′ to 8° 19′.

Ripley.—(106, 18.) A stream terminates in a marsh of 100 acres in section 4. The same is true of a long one near the northeast corner. In addition to these 15 marshes are laid down. They vary from 10 to 320 acres. Some wood is found but the township is mostly prairie. The magnetic variation varies from 7° 10′ to 8° 15′.

Claremont.—(107, 18.) Besides the marsh around Rice Lake, there are 8 small marshes varying from 5 to 60 acres. A band of wood runs through the township diagonally from the northwest, and two or three other small patches of wood are laid down. The magnetic variation varies from 7° 5′ to 8° 15′.

Ellington.—(108, 18.) A good many patches of marsh and wooded land are scattered over the township. Magnetic variation, 6° 48′ to 7° 56′.

TIMBER.

Heavy timber is found here as elsewhere in this part of the State along the streams. The list of plants would be nearly identical with that of Olmsted county. I will, therefore, give two lists, viz.: 1.—The plants seen in Dodge and not in Olmsted county. 2.—Plants seen in Olmsted and not in Dodge county.

1. Woody plants seen in Dodge but not in Olmsted county:

Moonseed. (*Menispermum Canadense. L.*)
Jersey Tea. (*Ceanothus Americanus. L.*)
Hawthorn. (*Crataegus coccinea. L.*)
Hawthorn. (*Cr. Crus-galli. L.*)
Wild Gooseberry. (*Ribes Cynosbati. L.*)
Large-leaved Dogwood. (*Cornus circinata. L'Her.*) Found in cold woods and bluffs.
Green Ash. (*Fraxinus viridis. Michx.*)
Sugarberry. *Celtis occidentalis. L.*)
Hop Horn-Beam. (*Ostrya Virginica. Willd.*)
Yellow Birch. (*Betula excelsa. Ait*)
White Pine. (*Pinus Strobus. L*) A few straggling specimens were seen in Olmsted county. There is a grove of the trees near Mantorville.
Balsam Fir. (*Abies balsamea. Marshall.*) With the preceding.
Common Juniper. (*Juniperus communis. L.*)
Red Cedar. (*J. Viginiana. L.*)

2. Plants found in Olmsted but not in Dodge county:

Poison Ivy. (*Rhus Toxicodendron. L.*)
Corky Elm. (*Ulmus recemosa. Thomas.*)
Hoary Alder. (*Alnus incana Willd.*)

It does not follow, by any means, that because I did not find the plants given above from one county in the other, they do not grow there. These lists are the results of observations hastily made as I drove through the counties. Many woody plants undoubtedly escaped me.

GEOLOGICAL STRUCTURE.

The outcrops of rock in this county are confined to the northeast portion. Canisteo, Mantorville, Milton, Concord and Wasioja townships include them all. Over the remaining seven townships the drift conceals every feature of the rock below. All the evidence that there is indicates that to some extent, at least, the rock so covered is Cretaceous, but I know of no facts of observation to demonstrate this.

The lowest formation found in the county is that of the *Shakopee Limestone.* This rock is known to enter the county from Olmsted, along the north branch of the Middle Fork of the Zumbro. For a distance of about 2¼ miles into the county is found the characteristic arrangement of bluffs surrounding a level valley. These bluffs are usually abrupt and approach much nearer to the north river bank than to the bank on the south. In several places in the bluffs the St. Peter Sandstone was actually observed. So that, though no Shakopee rock was actually seen within the limits of the county, the conclusion is a safe one that it does actually form the floor of the valley designated on the accompanying map.

Surrounding this valley is the bluffy outcrop of the *St. Peter Sandstone.* The structure of the bluffs gives a sure indication of its presence. Besides, as noted above, the rock was actually seen in several places. It was sometimes thrown out in digging wells,

and occasionally appeared at the side or in the bed of the road. It preserved its characteristic lithological character of a white, friable sandstone, growing reddish and attaining more consistency when exposed to the air.

The remaining exposures of rock along this stream are *Trenton Limestone*. In descending the stream everything is covered by drift until we reach the vicinity of Eagle Valley Mills, section 15, of the township of Concord. Near here a rock, in rather thin layers, is quarried. The quarries are on the surface, and no good exposure of the rock is found. It is, however, without doubt, Trenton stone. Two miles farther down the stream is a quarry on the south bank, at the village of Concord, (N. W. corner of sec. 23.) Here is a pretty good exposure with the rock as follows, beginning above:

4 ft. black loam and reddish clay.
2½ ft. rubble stone.
3 ft. of dolomitic rock, yellow, with fine reddish lines; layers broken 3-6 in. thick.
3 ft. of bluish stone, less dolomitic, in even beds 1-2 ft. thick.
1 ft. of bluish stone, not dolomitic in thin layers.
3½ ft. of heavy layers of bluish stone, not dolomitic.

17 ft. total exposure.

Below this is a compact limestone, not well exposed. It is not dolomitic and is good for burning.

At the sawmill near the middle of sec. 17, of Milton, the road passes around an exposure of rock. Here are about 10 feet of shaly limestone and blue clay. A fine specimen of *Receptaculites* lay in the wheel-track of the road, and had been considerably marred. Many other incomplete specimens were found.

An eighth of a mile below this saw mill, (still in sec. 17 of Milton,) is an irregular bluff on the south side of the stream. It is concealed by debris, bushes, etc., and not very accessible. The following measurements and observations were obtained with as much accuracy as circumstances would admit. They are taken from above:

10 ft. of yellowish limestone in thin layers.
1 ft. of compact aluminous layers in 2 or 3 layers.
15 ft. of shale, limestone and blue clay in alternate layers, usually thin.

Below, passing under the debris and probably occupying the present river-bed is a thick stratum of compact limestone, with a depth of upwards of 20 feet. *Receptaculites* are abundant in the rock.

As might be anticipated from the structure of the rock, living springs are abundant along these bluffs. One very fine one, the size of one's arm, pours out from the rock just above the sawmill, at a distance of 20 feet above the water of the stream. Here these springs are almost equal in numbers in bluffs facing north or south, betraying the absence of dip at this point in either of those directions.

Other small exposures of Trenton rock were seen in the road in

this stream no rock is found until in sec.
t quarry is that of Thomas Arnold, on the
in sec. 13 of Wasioja. At the top of the
5 feet of rubble stone. Below this are
arry stone, yellow when weathered, blue
edded layers, 6 in. to 3 ft. thick. It works
out flint. Near the bottom the rock was

on the same side of the stream, are the
two in number. This is in the village of
rock, of which he has 8 or 10 ft. exposed
thin, rather irregular fragments. It is
. Mr. Paul obtains from this a lime of a
burns about 840 bbls. per year, for which
el. He uses for this 86 cords of wood for
cord. Mr. Paul praises his lime highly,
n all hands to be good for laying stone.
aid to be slow in slacking and not strong.
astern edge of sec. 13 of Wasioja. At
of about 30 ft. of rock where materials
e mill and dam. The upper 5 ft. are of bro-
mainder is in solid, even beds, 6 in. to 3 ft.
estone, yellow, dolomitic, compact, coarse-

e Mantorville, in section 17 of Mantorville
posure of about 40 ft. of rock, on the north
are composed of a compact rock in thick
aring away very evenly by weathering, in
elow it the rock wears much more unevenly
the two lies a thin soft layer which was
s out much more rapidly than the other

From the stone in Ginsberg's quarry, his brewery, hardby, was made. It is one of the finest buildings in this part of the State. From the stone in the other quarries were made, the facings of the Court House, Schoolhouse and Cook's Hotel in Rochester; the public buildings and many of the stores at Mantorville; many railroad bridges along the Winona & St. Peter, the highway bridge at Owatonna, etc. The stone is especially prized for the following reasons:

1. It is evenly bedded and can be got out in good shape.
2. There is little grit or flint in it to take off the edge of tools. It therefore works easily.
3. It hardens after exposure.
4. The color is yellow or light blue and is pleasing.
5. There is little iron in it to cause discolored spots. Two or three such spots are seen in the Court House at Mantorville. The iron on weathering makes a rusty blotch on the surface of the stone. These ferruginous spots can be easily detected beforehand, and rock containing them should not be used for the outside.

Mantor's quarry lies on both sides of the stream. That on the north side is quite similar in rock and strata to that of Willson and Hook, described by Prof. Winchell. That on the south side of the stream, opposite and a little below the other, has the following section taken from above:

2 ft. of loose material, broken rubble stone.
1 ft. light yellow rock in layers 3 in. thick.
4½ ft. of yellow dolomitic rock in thick beds.
½ ft. of shaly, yellow rock, including a layer of 2 inches of an uncemented rather fine gravel, containing numerous black quartzite pebbles.
4 ft. yellow dolomitic rock, in thick beds.

12 ft. total exposure.

In the bed of the race at the second dam at Mantorville, 110 rods below the mill, sec. 21, is a fossiliferous green shale.

At Rockton Mills, sec. 22, Mantorville, is a considerable exposure. This section is given at p. 100, in the First Annual Report, under the head of "Section at Pettit's Mill." In secs. 14, 15, 21, 22, 23, occasional exposures, usually slight, were seen.

From the facts stated above, as well as those stated by Prof. Winchell, in his first annual report, the conclusion has been drawn that the Trenton occupies the bed of the stream as high as Wasioja, but that the bluffs are capped by Galena. This is the explanation of the long arm of blue color along the stream on the accompanying map.

Drift.—This covers nearly the whole county. Boulders are abundant and sometimes very large. Blue clay is said to underlie the whole of the southern and western part of the county. It lies at the depth of 10–30 feet, where it is always met in digging wells. Logs are sometimes found in it.

On the railroad between sections 32 and 33 of Wasioja the water washed out a ditch to a considerable depth so that the following section could be made:

2 ft. of black loam above.
6 ft. of yellow sandy clay with some small pebbles below.
4 ft. to bottom, alternations of thin ferruginous sandy films and black or yellowish sandy clay.

12 ft. total.

In the bottom of the ditch was a bluish quartzite bolder, 15 in. across, and 6 in. thick, worn off smoothly on one side by glacial action. The smooth side was polished, but scratched.

At the crossing of the railroad over the stream a similar section, 15 feet thick, was found. It was similar to the above except that the bottom clay was dark blue and without the ferruginous films. In this clay were numerous drift-pebbles; among others a piece of Galena limestone.

The boulders are numerous and usually granitic, syenitic or quartzose in character. In the railroad cuttings in Wasioja township, some ferruginous concretions of small size and much decayed, many fragments of Galena limestone and a solitary piece of argillite were found. Careful search was made for traces of the Maquoketa shales but they were not found.

Brick are made by Wm. Gutherless at Dodge Center. He makes 200,000 per year. They take 75 cords of wood at $2.75 per cord. The yellow or washed clay is employed. Mr. Gutherless puts in about one-third sand which keeps the brick from checking and warping. The bed of clay is worked for a thickness of 3 or 4 feet.

Three miles west of Dodge Center, Mr. Taylor made 222,000 brick last year. They are from the same clay. In a brick building which had been standing barely a year, quite a number of these brick had begun to crumble.

G. F. Rhodes, of Kasson, makes brick from a reddish washed clay obtained from a bank in the village of Mantorville. He makes about 600,000 brick per year. A kiln contains 120,000 and takes 40 cords of wood at a cost of $4.00 per cord. The brick sell at $7.00 per thousand. No sand is put in the clay, and the brick are machine pressed. The brick are tender, like others made from washed clay, except when the burn is exactly right.

The clay in the bed used by Mr. Rhodes varies in the amount of alumina. From the richest clay he has made a batch of drain tiles. They are tough and have the characteristic color of such tiles. He makes three sizes which he sells as follows:

2 inch bore at	$15 00 per thousand.
3 inch bore at	17 50 per thousand.
4 inch bore at	20 00 per thousand.

In sec. 17 of Milton Township, Jacob Baumgartner has a kiln in which he occasionally burns *lime*. I was unable to see either lime or quarry, but the former is said to be whitish and the stone is evidently Trenton Limestone.

In sec. 10 of Milton Township, N. Irish has a kiln in which he burns lime. The stone is a bed of Travertine, light, porous and soft, apparently 3 or 4 feet thick. The bed is at the base of a small

STEELE COUNTY.

BY M. W. HARRINGTON.

osition and size. This county lies in the second tier of coun- from the Iowa line. It lies next west of Dodge county, being fourth in number west from the Mississippi river. It has the n of a rectangle, and is bounded on the south by Freeborn, on west by Waseca, and on the north by Rice counties.

he name, position and size of the townships are as follows. The res were obtained from the office of the State Auditor, Hon. O. Whitcomb, with some additions from the office of the county ster:

Position and Area of the Townships.

Name.	T.	R.	Acres & Hundredths.
›ming Prairie	105	19	22,621.83
›ra	106	19	22,964.93
anna	107	19	22,254.04
ton	108	19	22,901.48
mit	105	20	22,982.43
erset	106	20	23,001.47
tonna	107	20	22,912.82
ton Falls	108	20	11,446.00
ford	108	20	11,433.57
in	105	21	22,805.78
ond	106	21	23,005.80
den	107	21	22,798.25
rfield	108	21	22,326.99

he total number of acres of land are seen to be 273,455.39. In ition to these there are about 428.66 acres of lake in Blooming irie; 676.33 in Havanna; 182.30 acres in Berlin; 144.46 in den; 601.79 in Deerfield. The total lake area in the county hus made 2,033.54 acres. Adding this to the acres of land, we e 275,488.93 as the total acreage in the county.

Surface.

This county is quite level, and is covered heavily by drift. As will be seen the rock appears at the surface only along the Straight River, near its exit from the county. Grassy swales are common and characteristic of the swamps, especially in Lemond township. Gravelly knoles are quite common in the most of the county, especially in the southern part. They are short and steep in the south part of Somerset and the adjoining parts of Summit and Blooming Prairie. A long straight ridge with many boulders runs nearly on the township line between Aurora and Somerset. The southern part of the county is called the Wilderness and is not thickly settled. The level of the Milwaukee and St. Paul Railroad has been already published. The writer has been unable to get access to that of the Winona and St. Peter Railroad.

The following notes were taken from the field-notes and plats of the government survey in Steele county, access to which was obligingly given me by the County Register. The surveys were made in 1854.

Blooming Prairie, (105, 19,) was covered by thickets and low scrub for the most part. Marshes were numerous and there were two small lakes in the northern part of the township. Magnetic variation, 8° 10′ to 9° 45′.

Aurora.—(106, 19.) This township much resembled the last; thickets and scrub over the most it and numerous marshes, some of them quite large. Magnetic variation, 7° 45′ to 9° 45′.

Havanna.—(107, 19.) This township contains the major part of Rice Lake. It is for the most part brushy or wooded, but the southwestern part is prairie. Marshes are numerous but not large. Magnetic variation, 7° 44′ to 9° 25′.

Merton.—(108, 19.) This township was found to be wooded on the south side and in the northwest corner. The remainder was prairie. A large marsh was located in sections 23 and 24, and many smaller ones were scattered over the county. Magnetic variation, 7° 37′ to 9° 23′.

Summit, (105, 20) was wooded in the eastern half, prairie in the western. A large branching marsh is located along the streams, and there are a few isolated marshes. A stream from the south loses itself in the southwest corner of section 20. Magnetic variation 9° 18′ to 10° 23′.

Somerset (106, 20) had several sections of prairie in the northeast corner, and the portion of the township lying west of the Straight River was prairie; otherwise it was wooded. The marshes platted are few and not large. Magnetic variation, 9° 13′ to 10° 45′.

Owatonna, (107, 20.) A band of woods, 2-5 miles wide, crosses the township accompanying the Straight River, and lying on its eastern bank The remainder is prairie. The banks of the stream were bluffy. Magnetic variation, 9° 10′ to 10° 45′. The site of the city of Owatonna was already in part claimed when the survey was made (1854.)

Clinton Falls (south half of 108, 20) was mostly wooded, though a wedge of prairie lay between the Straight River and Crane Creek.

There was also a little prairie on the eastern border. There was a long marsh platted in sections 26 and 27. Magnetic variation, 9° 10′—10° 30′.

Medford.—(north half of 108, 20.) This township is prairie, except for a wooded strip 2–4 miles wide, east of the river. The banks of the stream are rather bluffy. The claims of Sanburn, in section 16, Collings and Johnson, in 9, and Wright, in section 5, were already made. Magnetic variation, 8° 35′ to 10° 30′.

Berlin, (105, 21,) was wooded through the center of the township; the remainder was for the most part prairie. The plats indicate marshes along the streams, and some other scattered marshy spots. Near the center lie Looigana and Beaver lakes, and in the southwestern part a pond. Beaver Lake is now said to be deep and clear, and to contain only soft water. This item, and much other valuable information concerning this county, the writer owes to Rev. G. C. Tanner, superintendent of schools for the county. Magnetic variation, 8° 45′ to 10° 34′.

Lemond.—(106, 21.) The northwest part was woody and marshy, and there are besides two or three isolated groves of small extent. An extensive marsh crosses the north end of the township. Magnetic variation, 10° 00′ to 11° 13′.

Meriden.—(107, 21.) This township was nearly all prairie, a little wood being found north of Crane Creek and also a small amount in the southern part. The land along the creek was marshy. On the northern boundary a small lake was found. Magnetic variation, 10° 22′ to 11° 30′.

Deerfield.—(108, 21.) A lake enters from the south. Another of about 220 acres is platted just northeast of this, and near it is a pond of about half the size. All the township was wooded except the northwest corner, which was prairie. Extensive marshes were platted in the southern and western part. Magnetic variation, 9° 30′ to 11° 40′.

On comparing the magnetic variations given above, it is found that the extremes are 7° 37′ in Merton, and 11° 40′ in Deerfield, being a variation of more than 4° in one small county.

Drainage.

This county is well provided with lakes, as may be seen in the preceding notes. Marshes also are numerous. These are due to the level character of the country, and to the very slight elevation of one part above another. The small amount of the elevation is further shown by the sluggishness of the currents in the various streams. The course of the Straight river shows that what elevation there is in the county, its increase occurs as we travel southward. But, although the county is very nearly level and has little change in elevation within itself, its elevation with reference to the rest of the State is considerable. This is shown by the fact that two streams originate here, viz.: the Straight river, in the southern part of the county, and a branch of the Zumbro in Rice Lake. It is worthy of remark here, though it was mentioned in the report on

Dodge county, that Rice Lake has a natural outlet into the Straight river as well as into the Zumbro.

The small amount of fall of the streams limits the mill privileges in this county. The mills are found only on the Straight River, at Owatonna, and north.

The City Mills at Owatonna, Drought & Whitson, owners. They have 7 feet head of water, and three run of stone. It is a custom mill, but does a little flouring business.

Clinton Mills are at Clinton Falls, Sherman & Winship, owners. They have 10 feet head of water, and three run of stone. It is a custom and flouring mill.

Medford Mills are at Medford, White, Beynon & Co., owners. They have 10 feet of head of water and 4 run of stone. They do only a flouring business.

There is said to be an available water-power, unimproved, at Lindensmith's between Owatonna and Clinton Falls.

Timber.

The time spent in this county was not long enough to make out a list of the woody plants at all approaching completeness. The following were noted:

Basswood. (*Tilia Americana. L.*)
Smooth Sumach. (*Rhus glabra. L.*)
Wild Grape. (*Vitis.*)
Virginia Creeper. (*Ampelopsis quinquefolia. Michx.*)
New Jersey Tea. (*Ceanothus Americanus. L.*)
Sugar Maple. (*Acer saccharinum. Wang.*)
Silvery Maple. (*A. dasycarpum. Ehr.*)
Red or Swamp Maple. (*Acer rubrum. L.*)
Box-elder. (*Negrundo aceroides. Mœnch.*)
False Indigo. (*Amorpha fruticosa. L.*)
Locust. (*Robinia Pseudacacia. L.*) Cultivated.
Wild Yellow or Red Plum. (*Prunus Americana. Marshall.*)
Cherry. (*Prunus.*)
Red Raspberry. (*Rubus strigosus. Michx.*)
Blackberry. (*R. villosus. Ait.*)
Crab. (*Pyrus arbutifolia. L.*)
Dogwood. *Cornus paniculata. L'Her.*)
Wolfberry. (*Symphoricarpus occidentalis. R. Br.*)
Ash. (*Fraxinus.*)
Slippery Elm. (*Ulmus fulva. Michx.*)
White Elm. (*U. Americana. L. pl. Clayt.*)
Butternut. (*Juglans cinerea. L.*)
Walnut. (*Juglans nigra. L.*)
Hickory. (*Carya.*)
Bur Oak. (*Quercus macrocarpa. Michx.*)
Black Oak. (*Quercus coccinea, Wang. var tinctoria, Bartram.*)
Wild Hazel-nut. (*Corylus Americana. Walt.*)
Iron-wood. (*Ostrya Virginica. Willd.*)
America Aspen. (*Populus tremuloides. Michx.*)
Cottonwood. (*P. monilifera. Ait.*)
Largetoothed Aspen. (*P. grandidentata. Michx.*)
Balm of Gilead. (*P. balsamifera. L. Var. candicans. Ait.*) Cultivated

The heaviness of the drift over this county effectually covers all he rock. The slight fall of the river enables it to uncover but little hus covered up. The only exposure of rock in the county is at indensmith's, about two miles below, and this exposure is but a ight one.

The rock is *Trenton Limestone*, and is first met at John Abbott's narry, in section 33, of Clinton Falls. It is in the bed and on the ow banks of the Straight River. The exposure at the time vised extended only about 4 feet above the surface of the water. he rock is in horizontal layers, 2–6 inches thick. It is blue on esh fracture, yellow when weathered, compact, sparry, and contains many minute fragments of blue shale, like the corresponding ock at Minneapolis.

Just below, on section 28, is Lindensmith's quarry. The rock is thicker layers than in Abbot's quarry. The following section as seen in one place, beginning above:

2 feet loam.
2 feet blue clay and limestone in thin layers.
4 feet—to water's surface—compact blue limestone, in thin layers.

The rock is like that in Abbott's quarry. Near by was another section as follows:

2½ ft. black and red loam.
2 ft. hard yellow clay.
7 ft. blue stone in layers 2-5 inches thick, extending to surface of water.

Below this there is no more rock until the county line is passed. At Wolcott Mills, about 1½ miles in Rice county, blue Trenton limestone has been quarried in the bed of the river.

No fossils were found in the rock. This stone is used for flagging and other purposes at Owatonna, and is considered a good stone.

Some evidence of the existence of a *Cretaceous* area in the State was found. On the southeast quarter of section 26, of Deerfield, on the farm of Aug. Hoffmann, coal has been found in sinking a well. Dr. G. A. Rossbach tells the writer that they went through 25 feet of black-blue clay, in the under part of which were fragments of coal. After that they passed through gravel in which also were coal fragments. At the depth of 63 or 64 feet rock was struck, the drill showed it to be black slate with pieces of coal imbedded in it. Although no specimens of the coal were seen by the writer the description given would answer for Cretaceous lignite. When the matter is further explored by capitalists which will, in probability, soon happen, all doubt as to the geological horizon of the rock will be cleared up. Meantime the evidence from the geology of adjoining counties, as well as the nature of the rock itself, justifies us in calling the rock Cretaceous. Just west of Owatonna another farmer is said to have struck coal also, though the writer was unable to get any further information on the matter.

The *Drift* is here, as already mentioned, very heavy. Sections of it were seen at several places. A gravel-knoll cut through at Owatonna showed one foot of black loam on the top, then four feet of yellow, sandy clay, then seven feet of assorted sand and gravel. Other sections along the railroads showed essentially the same arrangement. Among the gravel-pebbles, fragments of argillite were common.

The Owatonna mineral springs should be mentioned. They are nine in number, and are located about one and one-half miles northeast of the city. They lie along Maple Creek, at the base of a low clayey bluff. Of the five seen by the writer, four deposited iron. The water of the fifth had a decidedly bluish tint. Fountain spring was put down 22 feet and now flows out freely, raising the water about five feet above the surface. The others are natural springs. They are all undoubtedly due to the clay-floor underlying the loose materials of the drift. The taste of the water in the five visited by me was slightly mineral. The analysis of the water, published by the Owatonna Mineral Springs Company is appended. To which of the springs this analysis belonged could not be ascertained:

In one gallon, or 231 cubic inches, there are:

Chloride of Sodium	.1680	grains.
Sulphate of Sodium	.2856	"
Bicarbonate of Sodium	1.8592	"
Bicarbonate of Calcium	18.1992	"
Bicarbonate of Magnesium	5.2920	"
Bicarbonate of Protoxide of Iron	.6160	"
Alumina	.2800	"
Silica	1.1200	"
Organic Matter	a trace.	
Total	22.8200	grains.

Cornell Brothers, at Owatonna, manufacture stoneware. The clay employed is a fine, rich, plastic, blue clay, and is at present obtained from Eldora, Hardin county, Iowa. This bed of clay is being exhausted, and its quality is deteriorating. This has determined the firm to try a gray clay found about one mile east of Owatonna. This is the same layer of clay which crops out at the mineral springs near the city. It has been found to work well. Excellent fire-brick is made from this clay. This firm has just started in business. They make about 1,000 gallons a week in jars, jugs, &c.

Dr. E. N. Morehouse makes brick from a bluish, yellow, washed clay, near Owatonna. He puts in the clay about one-third sand. He makes 225,000 bricks a year, for which he charges $8.00 to $12.00 per thousand, according to quality. He uses 50 cords of wood for every 100,000 of bricks. The wood costs $3.00 per cord at the place of cutting. The bricks are, like all of those made from the washed clay, not first-class. Dr. Morehouse has experimented on making unglazed red ware from his clay, with fair results.

Odell and Cornell also make bricks near Owatonna. Bricks are also made on the farm of Mr. Skinner, near Blooming Prairie.

An artesian well has been subscribed for at Owatonna, and will probably soon be sunk. It must obtain results of great value for the Geological Survey.

The lists of railroad elevations given in the first annual report carried a net work of levels over the most of the inhabited portion of the State. They demonstrate the nearly level condition of the general surface of the State. The changes of level are, in that portion through which railroad lines have been run, of the nature of broad swells in the substructure, and indicate the changes in the geological formations, that bring on a series of hard and very enduring rocks, or a thickness of more erosible layers. Thus the Upper Devonian, in the southern tier of counties, is characterized by a considerable elevation above the formations that underlie it. The level surface that characterzes the Cretaceous in Steele and Dodge counties, as well as in much of the western part of the State, is attributable to the effect of that formation in toning down, and concealing, the irregularities in the old Devonian and Silurian surfaces. Thus there subsists a very intimate relation between the topography and the geology in the various parts of the State. The illustrations that have already been given in the report on the geology of Fillmore county, are still more striking proofs that the topography of a country is that which gives the first response to the enquiring geologist when locating the geological boundaries. For this reason it is highly desirable that all lines of railroad survey, which have been run in the State, should be made tributary to this end. It matters but little whether the railroads for which such surveys were intended were ever constructed. All that is needed is the comparative hights of the points along a known line. The undulations of the surface are very significant to the geologist.

The following lists are given as a further contribution to this subject. They have been furnished by the engineers of the Chicago, Milwaukee and St. Paul Railroad, and refer the points named to the level of the ocean. They pass through some of the principal cities and the wealthiest counties of the State.

RAILROAD ELEVATIONS.

THE CHICAGO, MILWAUKEE AND ST. PAUL R. R.

From the Records, by Robert Angst.

IOWA AND MINNESOTA DIVISION.

[*Note.*—The track is designated in all cases, when not otherwise mentioned.]

	Above the Ocean.
	Feet.
State Line, Lyle	1,099.46
Rose Creek, (Grade)	1,085.41
Rose Creek, (Bottom)	1,068.06
Dobin's Creek, (Grade)	1,094.76
Dobin's Creek, (Bottom)	1,071.46
Y at Austin Junction	1,094 45
Austin, (Station)	1,097.06
Wolf Creek. (Grade)	1,103.06
Wolf Creek, (Bottom)	1,076.06
Cedar River, (Grade)	1,100.00
Cedar River, (Bottom)	1,080.06
Ramsay, (Crossing S. M. R. R.)	1,114.86
Indian Creek, (Grade)	1,110.06
Indian Creek, (Bottom)	1,096.56
Lansing	1,124 06
Ingham's Creek, (Grade)	1,120.86
Ingham's Creek, (Bottom)	1,107.56
Top of swell, NE. ¼ Sec. 33, Udolpho, (Cut 3½ feet)	1,143.56
Swell, half a mile south of Madison, (Cut 1½ feet)	1,149.56
Madison	1,150.06
Top of divide 7½ miles N. of Madison, (Natural Surface)	1,149.50
Top of divide 7½ miles N. of Madison, (Grade)	1,146.00
Blooming Prairie, (Depot)	1,185.76
One-half mile S. E. of Aurora, (Bottom of marsh)	1,106.56
One-half mile S. E. of Aurora, (Grade)	1,114,56
Aurora Station. Sec. 17, Aurora Township.	1,150.66
Havana. S. W. ¼ sec. 31	1,118,62
Top of divide between Havana and Owatonna. Sec. 24, (Grade and natural surface)	1,141.06
Winona and St. Peter Crossing. Owatonna	1,041.56
Owatonna, (Depot)	1,041.56

		t
Maple Creek, (Grade)		
Maple Creek, (Bottom)		
Clinton Divide. Section 21, ¼ mile South of road-crossing, (cut 2 feet)		
Medford		
Straight River, (Grade)		
Straight River, (Bottom)		
Divide in Wolcott. S. W. ¼ sec. 19, (Natural surface)		
Divide in Wolcott. S. W. ¼ sec. 19, (Grade)		
Faribault		
Cannon River, (Grade)		
Cannon River, (Bottom)		
Divide in Cannon City Township. N. E. ¼ sec. 24, (Natural surface)		
Divide in Cannon City Township. N. E. ¼ sec. 24, (Grade)		
Bottom of swamp, five miles N. of Faribault		
Five miles N. of Faribault, (Grade)		
Divide, S. W. ¼ sec. 31. Bidgewater, (Natural surface)		
Divide, S. W. ¼ sec. 31. Bridgewater, (Grade)		
Wolf Creek, (Grade)		
Wolf Creek, (Bottom)		
Dundas. Depot		
Spring Creek, 1¾ miles S. W. of Northfield, (Grade)		
Spring Creek, 1¾ miles S. W. of Northfield, (Bottom)		
Heath Creek, (Grade),		
Heath Creek, (Bottom)		
Northfield. Depot		
S. end of Plateau, 2 ms. N. of Northfield, (Nat. sur.)	Sec. 19, Waterford.	
S. end of Plateau, 2 ms. N. of Northfield, (Grade)	Sec. 19, Waterford.	
N. end of Plateau, 3 ms. N. of Northfield, (Nat. sur.)	Sec. 19, Waterford.	
N. end of Plateau, 3 ms. N, of Northfield, (Grade)	Sec. 19, Waterford.	
Foot of slope, near Chub Creek, (Grade and nat. sur.)		
Foot of slope, 5 miles from Northfield, (Natural Surface)		
Foot of slope, 5 miles from Northfield, (Grade)		
Castle Rock Depot		
Divide, sec. 18, Castle Rock Tp., (Natural Surface)		
Divide, sec. 18, Castle Rock Tp., (Grade)		
Divide, one mile south of Farmington, (Natural Surface)		
Divide, one mile south of Farmington, (Grade)		
Farmington		
Farmington, Crossing H. & D. R. R		
Vermillion River Crossing, (Bottom)		
Vermillion River Crossing, (Grade.) Rolling surface to—		
Rosemont Depot. Rolling surface to—		
Westcott Station		
St. Paul Junction, (at Mendota)		
Crossing of the St. Paul & Sioux City R. R., Mendota		
Mendota Junction		
Crossing of the Minesota River. Fort Snelling		
Crossing of the Minnesota River, (Bottom)		
Fort Snelling Station		
Minnehaha Station		
Minnehaha Creek (grade)		
Minnehaha Creek (bottom)		
Minneapolis Depot		

McGregor Division.

	Above the Ocean.
	Feet.
State Line, near Le Roy, Mower county (Nat. Sur. and Grade)..	1,163.47
Le Loy Depot	1,180.57
Divide, section 28, Le Roy, (Natural Surface)	1,205.47
Creek 2¼ miles west of Le Roy (Grade)	1,185.67
Creek, 2¼ miles west of Le Roy (Bottom)	1,167.97
Creek, 2¾ miles west of Le Roy (Grade)	1,185.67
Creek, 2¾ miles west of Le Roy (Bottom)	1,170.47
Taopi, (formerly Bellevue) section 16, Lodi (Grade)	1,236.47
Divide, ⅛ mile west of Taopi section 17 (Natural Surface)	1,245.47
Divide, ⅛ mile west of Taopi section 17 (Grade)	1,243.47
Adams, (Grade)	1,176.47
Creek, ¼ mile west of Adams, (Grade)	1,174.47
Creek, ¼ mile west of Adams, (Bottom)	1,159.47
Little Cedar river crossing (Grade)	1,172.47
Little Cedar river crossing (Bottom)	1,152.47
Divide, ¾ mile west of the Little Cedar (Natural Surface)	1,208.47
Divide, ¾ mile west of the Little Cedar (Grade)	1,201.17
Rose Creek Station	1,144.97
Rose Creek Crossing, (Grade)	1,136.47
Rose Creek Crossing, (Bottom)	1,122.47

River Division.

Low water at St. Paul	672.84
Grade of the L. S. & M. R. R., St. Paul, (near the old warehouse on the trestle work)	692.84
Dayton's Bluff, St. Paul, (Grade of R. R.)	696.34
Newport Station	737.87
Langdon	799.84
Hastings Depot, (Junction H. & D. R. R.)	696.31
Etter	677.84
Red Wing	673.84
Frontenac	707.34
Lake City	691.84
Reed's Landing	669.34
Wabasha	699.24
Kellogg	689.09
Weaver	660.84
Minneiska	659.44
Minnesota City	664.44
Crossing of the Winona & St. Peter R. R. (St. Peter Junction).	662.92
Winona	649.44
Homer	650.54
La Moille	647.44
Richmond	660 94
Dakota	644.44
Dresbach	663.44
La Crescent lime kiln, N. side of Houston county (Grade)	637.44

	Above the Ocean.
	Feet.
Hastings. Junction with the River Division Mil. & St. P. R R.	696.31
Edge of prairie 3 miles W. of Hastings, Sec. 5, Marshan, (Grade and Nat. Surf.)	814.31
Thence slightly rolling surface, or nearly level, to—	
line and a half miles W. of Hastings, (Grade)	814.31
line and a half miles W. of Hastings, (Nat. Sur.)	822.31
auburn	848.81
Sec. 27, Empire. Change of grade, (Nat. Sur.)	877.31
Sec. 27, Empire. Change of grade, (Grade)	876.31
Farmington, Crossing of the I. and M. Division	891.31
Fairfield, (Lakeville)	930.31
1½ miles from Hastings, (Nat. Surface)	1,079.31
1½ miles from Hastings, (Grade)	1,069.81
mile E. of Prior Lake Station, (Natural Surface)	960.31
mile E. of Prior Lake Station, (Grade)	948.31
Prior Lake Station	936.31
Prior Lake, (Surface of water)	896.31
Prior Lake Crossing, (Bottom)	871.31
at ½ mile W. of Prior Lake Crossing, (Nat. Surface)	952.81
at ½ mile W. of Prior Lake Crossing, (Grade)	926.31
at 3 miles W. of Prior Lake Station, (Nat. Surface)	915.31
at 3 miles W. of Prior Lake Station, (Grade)	890.31
miles W. of Prior Lake Station, (Nat. Surface)	749.81
miles W. of Prior Lake Station, (Grade)	750.81
Shakopee, Crossing of the Sioux City R. R	742.81
Shakopee, Crossing of the Minnesota River, (Bottom)	657.31
Shakopee, Crossing of the Minnesota River, (Low water)	679.31
Shakopee, Crossing of the Minnesota River, (High water)	706.41
[Extreme range of water, 27.1 feet.]	
Shakopee, Crossing of the Minnesota River, (Grade)	714.31
Chaska depot	715.21
Chaska, Crossing of the Minneapolis and St. Louis R. R	716 81
Carver depot	802.11
Carver, Crossing of highway ¼ m. W. of depot, (Ravine, Bottom of)	736.31
Carver, Crossing of highway ¼ m. W. of Depot, (Grade)	805.00
Dahlgren, (Grade)	968.81
Dahlgren Station, (Nat. Surface)	975.81
Divide ½ m. W. of Dahlgren Station, (Nat. Surface)	976.31
Divide ½ m. W. of Dahlgren, (Grade)	970.31
Carver Creek crossing, (Bottom)	895.31
Carver Creek crossing, (Grade)	917.31
Benton Station, Divide, (Natural Surface)	943.31
Benton Station, Divide, (Grade)	934.31
Divide ¾ m. W. of Bonngard's Crossing, (Nat. Surface)	987.31
Divide ¾ m. W. of Bonngard's Crossing, (Grade)	978.31
Young America	977.31
Tiger Lake, Sec. 16, (Surface of water)	966.31
Divide 3½ miles W. of Young America; ½ m. E. of County Line, (Nat. Surface)	997.31
Divide 3½ ms. W. of Young America; ½ m. E. of Co. Line, (Grade)	991.31
Buffalo Creek Crossing, (Bottom)	953.31
Buffalo Creek Crossing, (Grade)	970.00
Divide ½ mile E. of Glencoe, (Nat. Surface)	1,013.31
Divide ½ mile E. of Glencoe, (Grade)	1,008.31
Glencoe Depot	990.01

" 3,510.....
" 3,560.....
" 3,570.....
" 3,585.....
" 3,600.....
" 3,625.....
" 3,645.....
" 3,655.....
" 3,680.....
" 3,693.....
" 3,710.....
" 3,725.....
" 3,780.....
" 3,840.....
" 3,866.....
" 3,880.....
" 4,000.....
" 4,100.....
" 4,140.....
(Undulations 5–10 feet.)
" 4,300.....
" 4,390.....
" 4,400.....
" 4,500.....
" 4,600.....
" 4,610.....
" 4,663.....
" 4,706.....
" 4,720.....
" 4,740.....
" 4,762.....
" 4,774.....
" 4,780.....
" 4,802.....(E. Fork of Beaver (
" 4,820.....
" 4,860.....
" 4,870.....
" 4,940.....

		Above the Ocean.
		Feet.
Station,	5,230	1,057.00
"	5,260	1,072.00
"	5,300	1,056.00
	(Undulations of 15 feet.)	
"	5,300	1,043.00
"	5,420 (Sec. 13-18, R. 37-36.)	1,042.00
	(Undulations.)	
"	5,460	1,022.00
"	5,490	1,046.00
"	5,570	1,056.00
"	5,610	1,041.00
	(Undulations between 1,036 and 1,051.)	
"	5,740	1,031.00
"	5,750	1,026.00
"	5,760	1,038.00
"	5,790	1,048.00
"	5,810	1,031.00
"	5,830	1,039.00
"	5,900	1,026.00
"	5,930	1,038.00
"	5,947	1,023.00
"	5,970	1,036.00
"	6,020	988.00
"	6,023 (Hawk Creek)	970.00
"	6,030	999.00
"	6,040	1,007.00
"	6,090	1,009.00
"	6,094	1,010.00
"	6,096 (Creek)	989.00
"	6,100	1,008.00
"	6,140	1,012.00
"	6,142	996.00
"	6,145	1,012.00
"	6,230	1,031.00
"	6,315	1,010.00
"	6,340	1,018.00
"	6,400	1,004.00
"	6,417	988.00
"	6,460	1,021.00
	(Undulating 5-10 feet.)	
"	6,600	1,014.00
"	6,625	985.00
"	6,660	997.00
"	6,672	988.00
"	6,730	1,008.00
"	6,770	987.00
"	6,820	1,000.00
"	6,824	1,001.00
"	6,826	980.00
"	6,828	996.00
"	6,850	980.00
"	6,870	970.00
"	6,880	983.00
"	6,910	978.00
"	6,930	941.00
"	6,960	959.00
"	6,968 (R. 40-41, Sec. 31-36.)	959.00
"	6,990	934.00

		Above the Ocean.
		Feet.
Station,	7,070	931.00
"	7,090	925.00
"	7,149	928.00
"	7,150 (Chippewa River)	913.00
"	7,154	931.00
"	7,260	918.00
"	7,320	934.00
"	7,350	915.00
"	7,370	913.00
"	7,390	933.00
"	7,408	925.00
"	7,405	940.00
"	7,415	932.00
"	7,426	950.00
"	7,432	941.00
"	7,490	968.00
"	7,590	974.00
"	7,603	991.00
"	7,630	986.00
"	7,645	969.00
"	7,690	977.00
"	7,790	980.00
"	7,860	997.00
"	7,910	981.00
"	8,030	986.00
"	8,039 (Pomme de Terre River)	960.00
"	8,050	985.00
"	8,120	994.00
"	8,240	1,000.00
"	8,310	986.00
"	8,370	996.00
"	8,390	1,017.00
"	8,420	1,018.00
"	8,480	987.00
"	8,500	985.00
"	8,560	991.00
"	8,580	986.00
"	8,640	1,002.00
"	8,700	1,012.00
"	8,800	1,017.00
"	8,850	1,038.00
"	8,880	1,012.00
"	8,930	1,015.00
"	8,970	1,018.00
"	8,994–5	973.00
"	8,998–9,000	990.00
"	9,003. (Creek)	965.00
"	9,008	1,011.00
"	9,030	1,017.00
"	9,060, (Sec. 13, 121.46)	1,006.00
"	9,100	1,041.00
"	9,110	1,044.00
"	9,140	1,068.00
	(Undulations, 10–15 feet.)	
"	9,170	1,072.00
"	9,190	1,079.00
"	9,200, (Opposite foot of Big Stone Lake, 1½ ms. SE. of it)	1,077.00
	Big Stone Lake, opposite Sta. 9,316	938.50

REPORT ON THE GENERAL MUSEUM.

CONTAINING THE COLLECTIONS OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY FOR 1875.

BY N. H. WINCHELL, CURATOR.

The Museum of the State University, at Minneapolis, is designed to exemplify to the people of the State the natural resources of the State of Minnesota, so far as the same are covered by the investigations ordered by the law creating a geological and natural history survey. It is also designed to afford to the students who may avail themselves of the instruction offered by the University, the means of illustration needed in the study of the Natural Sciences. In addition to the collections directly made by the survey, the law orders a system of exchanging with other institutions with a view of so augmenting the number of specimens on exhibition as to comprise finally a tolerably complete series of the different species and objects of interest and curiosity that are afforded by the Natural Sciences.

Prior to the commencement of the Geological and Natural History survey, there was a nucleus of a museum already in existence in the University. This comprised a variety of objects, many from the State of Minnesota, and others from foreign localities. The collections that have accumulated since the survey began have been withheld necessarily from exhibition owing to the lack of suitable room with proper cases and furniture for their exhibition and preservation. During the past year, however, the new University building having been substantially completed, room has been set aside for the museum, and a set of cases are rapidly approaching completion, suitable for the reception of some, if not all, of the collections that belong to the museum.

The mammals that were collected in the Black Hills, mentioned in the last statement on the condition of the museum, have been mounted by Prof. H. A. Ward, of Rochester, New York, and are only awaiting the arrangement of the room to be set up in the University. They comprise antelope, male and female, deer with young,

elk, elk head, badger, grizzly bear with young, and weasel. The moose which was secured last winter has also been mounted by Prof. Ward, and for the same reason is not on exhibition. It is kindly kept in store by Prof. Ward till our rooms are ready. This fine specimen was killed in December, 1874, by Peter Young, ("Wild Pete,") in the east part of Otter Tail county, on the north end of Parker's Prairie, after having been pursued about five miles. He was seen about a mile away, coming toward the hunter, on a trot, and passed within six rods of him. The first shot put a ball through his throat, but it required four or five more to bring him down. He was billed as freight to St. Paul, after the entrails were removed, with a weight of 590 pounds. His flesh and bones, without the neck and lower leg-bones, weighed 465 pounds. The specimen, as mounted, is pronounced one of rare size and perfection. In procuring and caring for this moose, before he was sent to Prof. Ward, Messrs. Wm. A. Van Slyke and Merrill Ryder, both of St. Paul, rendered much assistance.

In August the generosity of a few citizens of Minneapolis aided the Board of Regents to make the purchase of a fine set of Prof. Ward's casts. These are in plaster of paris, and are of life size, and will give the rooms assigned to the Museum a very attractive appearance: The contributors to this fund were the following gentlemen:

Judge E. S. Jones	$50 00
Gov. J. S. Pillsbury	150 00
Hon. L. Butler	150 00
Dr. H. H. Kimball	10 00
R. J. Mendenhall	10 00
Hon. E. M. Wilson	10 00
Hon. R. B. Langdon	50 00
Hon. H. T. Welles	50 00
S. C. Gale, Esq	25 00
Chute Brothers	10 00
Judge Isaac Atwater	15 00
D. S. Story	5 00
Jonathan Chase	100 00
Anthony Kelly	5 00
Wyman Elliott	5 00
Thomas Lowry	25 00
Hon. A. M. Reid	25 00
Hon. Paris Gibson	25 00

The full cost of the set was $1,500. It embraces the following specimens:

LIST OF WARD'S CASTS OF FOSSILS IN THE UNIVERSITY MUSEUM.

VERTEBRATA.

MAMMALIA.

[NOTE.—The numbers prefixed are those of Prof. Ward's Catalogue.]

2. Homo.....Engis Cavern, Belgium.
Pleistocene.

4. Homo.....Guadaloupe.
Modern Concretionary Limestone.

4. (C.L.) Mesopithecus Pentelici. *Wagner*.....Pikermi, Greece.
Upper Miocene.

7. (C. L.) Machairodus cultridens. *Cuv*.....Pikermi, Greece.
Upper Miocene.

11. Hyæna eximia. *Wagner*.....Pikermi, Greece.
Pleistocene.

15. Amphicyon major. *Lartet*.....Sansans, S. France.
Miocene Tertiary.

16. Ursus spelæus. *Blum*, (skull.).....Cave of Gailerneuth, Bavaria.
Quaternary.

17. Ursus spelæus. *Blum*, (pair of molars).Cave of Gailenreuth, Bavaria.
Quaternary.

18. Ursus spelæus. *Blum*. (canine tooth.)..Cave of Gailenreuth, Bavaria.
Quaternary.

19. Gulo spelæus. *Goldf*.....Cave of Gailenreuth, Bavaria.
Quarternary.

20. Trogontherium Cuvieri. *Fisch*.....Ostend, England.
Pliocene Tertiary.

21. Castoroides Ohioensis. *Foster*.....Clyde, N. Y.
Pleistocene.

23. Megatherium Cuvieri. *Desm*.....Buenos Ayres, S. A.
Pampean Formation.

26. Megatherium Cuvieri. *Desm*. (tooth.).....Buenos Ayres, S. A.
Pleistocene.

34. Megalonyx Jeffersonii. *Harlan*.....Henderson, Ky.
Pleistocene.

35. Megalonyx Jeffersonii. *Harlan*.....Cave, West Virginia.
Pleistocene.

36. Glyptodon typus. *Nodat*.....Pampean Deposit, Buenos Ayres.
Pleistocene.

41. Glyptodon reticulatus. *Owen.* (caudal armor.).....Buenos Ayres. Pleistocene.

43. Glyptodon clavipes. *Owen.* (reduced.).....Buenos Ayres. Pleistocene.

54. Bootherium cavifrons. *Leidy*.....Ft. Gibson, Indian Territory. Pleistocene.

55. Bootherum bombifrons. *Leidy*.....Big-bone Lick, Ky. Pleistocene.

57. Oreodon Culbertsonii. *Leidy*.....Mauvaises Terres, Neb. Miocene Tertiary.

59. Anoplotherium commune. *Cuv*.....Montmatre, Paris. Eocene Gypsum.

60. Anoplotherium commune. *Cuv.* (right forefoot)..Montmatre, Paris. Eocene Tertiary.

61. Anoplotherium commune. *Cuv.* (left hindfoot)...Montmatre, Paris. Eocene Tertiary.

69. Chœropotamus Parisiensis. *Aym.* (skull).....Montmatre, Paris. Eocene Tertiary.

71. Anthracotherium magnum. *Cuv*.....Auvergne, France. Miocene Tertiary.

72. Lophiochaerus splendens.....St. Albans, France. Miocene Tertiary.

73. Hippohyus Sivalensis. *Falc. and Caut*.....Sewalik Hills, India. Miocene Tertiary.

78. Hippopotamus major. *Cuv.* (right tusk.)

79. Hippopotamus major. *Cuv.* (left hindfoot).....Auvergne, France. Pliocene Tertiary.

80. Equus namadicus. *Falc. and Caut*.....Sewalik Hills, India. Miocene Tertiary.

83. Hipparion elegans. *Christol*.....Concurron, France. Lower Pliocene.

87. Anchitherium Aurelianense. *Gerv*.....St. Alban, France. Upper Miocene.

89. Rhinoceros platyrhinus. *Falc. and Caut*.....Sewalik Hills, India. Miocene.

90. Rhinoceros palæindicus. *Falc. and Caut*.....Sewalik Hills, India. Miocene Tertiary.

95. Rhinoceros pleuroceros, (lower jaw).....Gannat, France. Miocene Tertiary.

99. Rhinoceros Merkii. *Kaup*.....Steinheim, Wirtemberg. Miocene Tertiary.

100. Rhinoceros incisivus. *Cuv.*, (upper incisor).....Steinheim, Germ. Miocene Tertiary.

102. Tapirus Avernensis. *Croiz and Job*.....Auvergne, Central France. Pliocene Tertiary.

103. Tapirus Avernensis. *Croiz. and Job*.....Auvergne, France. Plocine.

104. Lophiodon Parisiense. *Gerv*.....Paris, France. Eocene Tertiary.

105. Pliolophus vulpiceps. *Owen*.....England. London Clay (Eocene.)

106. Palæotherium crassum. *Cuv*.....Montmartre, Paris. Eocene Gypsum.

Palæotherium crassum. *Cuv.*.....Monturartre, Paris.
Eocene Gypsum.

Palæotherium crassum. *Cuv.*, (left hind foot).....Paris, France.
Eocene Tertiary.

Dinotherium giganteum. *Kaup*.....Eppelsheim, Rhine Valley.
Miocene Tertiary.

Dinotherium levius, (upper jaw, left ramus).....St. Albans, France.
Miocene Tertiary.

Dinotherium levius, (upper jaw).....St. Albans, France.
Miocene Tertiary.

Dinotherium giganteum. *Kaup*.....St. Jean le Vieux, France.
Miocene Tertiary.

Elephas primigenius. *Blum*.....Lippe, Prussia.
Pleistocene.

Elephas primigenius. *Blum*.....Dept. of Ain, France.
Pleistocene.

Elephas intermedius, (molar.).....River Saone, France.
Pleistocene.

Elephas intermedius, (molar.).....St. Germain, France.
Pleistocene.

Elephas meridionalis. *Nesti*.....Basses Alpes, France.
Pliocene Tertiary.

Elephas Americanus. *Dekay*.....Homer, Cortland Co., N. Y.
Pleistocene.

Elephas Americanus. *DeKay*.....St. Catharines, C. W.
Pleistocene.

Mastodon giganteus. *Cuv.* (molar).....Big Bone Lick, Ky.
Pleistocene.

Mastodon longirostris. *Kaup* (molar).....Lyons, France.
Miocene Tertiary.

Mastodon longirostris. *Kaup.* (tusk of lower jaw)...Lyons, France.
Miocene Tertiary.

Mastodon giganteus. *Cuv*.....St. Catharines, C. W.
Pleistocene.

Zeuglodon cetoides. *Owen.* (two teeth).....Claiborne, Ala.
Eocene Tertiary.

Rhizoprion Schinzi, (head.).....Central France.
Miocene Tertiary.

Balaenodon gibbosus. *On.* (tympanic bones).....Suffolk, England.
Pliocene Tertiary.

Diprotodon Australis. *Owen*.....Darling Downs, Australia.
Pleistocene.

AVES.

Didus ineptus, (head).....Mauritius.
Alluvium.

Æpiornis maximus. *St. Hil.* (egg).....Madagascar.
Pleistocene.

Æpiornis maximus.. *St. Hil.* (metatarsal).....Madagascar.
Pleistocene.

Palapteryx ingens. *On.* (right foot).....New Zealand.
Pleistocene.

189. Brontozoonm gigantum. *Hitch.* (tracks).....Northampton, Mas
Lias.

192. Brontozoonm Sillimanium. *Hk.* (tracks).....Middletown, Con
Lias.

REPTILIA.

196.′ Polemarchus gigas. *Hk.* (track).....Chicopee Falls, Ma
Lias.?

149. (C. L.) Iguanodon Mantelli. *Meyer*.....Isle of Wig
Wealden.

211. Ichthyosaurus communis. *Conyb*.....Lyme-Regis, Englan
Lias.

212. Ichthyosaurus communis. *Conyb.* (head).....Barrow-on-Soar, En
Lias.

213. Ichthyosaurus communis. *Conyb.* (head).....Lyme-Regis, En
Lias.

214. Ichthyosaurus commnnis. *Conyb.* (paddle).....Boll, Wirtembe
Lias.

219. Ichthyosaurus platyodon. *Conyb*.....Lyme-Regis, En
Lias.

220. Ichthyosaurus tenuirostris. *Conyb*.....Boll, Wirtembe
Lias.

222. Ichthyosaurus tenuirostris. *Conyb*.....Boll, Wirtembe
Lias.

225. Plesiosaurus dolichodeirus. *Conyb*.....Glastonbury, En
Lias.

227. Plesiosaurus macrocephalus. *Conyb*.....Lyme-Regis, En
Lias.

231. Pliosaurus brachydeirus. *Owen.*, (paddle).....Dorchester, En
Upper Oolite.

233. Pliosaurus grandis. *Owen*, (tooth).....Dorchester, En
Upper Oolite.

237. Placodus gigas. *Agass*.....Laineck, Bava
Muschelkalk (Trias.)

239. Placodus gigas. *Agass*.....Laineck, Bava
Muschelkalk (Trias.)

241. Pterodactylus crassirostris. *Goldf*.....Solenhofen, Bava
Upper Oolite.

242. Pterodactylus rhamphastinus. *Wagner*.....Solenhofen, Bava
Middle Oolite.

247. Crocodilus biporcatus. *Cuv.* (head).....Sewalik Hills, In
Miocene Tertiary.

249. Crocodileimus robustus.....Dept. of Ain, Fra
Upper Oolite.

251. Aligatorellus Beaumontii.....Dept. of Ain, Fra
Middle Oolite.

253. Teleosaurus Mandelslohi. *Bronn*.....Holzmaden, Wirtemb
Lias.

255. Teleosaurus longipes. *Bronn*.....Boll, Wirtemb
Lias.

256. Teleosaurus Cadomensis. *St. Hil.* (ventral scales)....Caen, Fra
Lower Oolite.

262. **Mosasaurus Hoffmanni.** *Mantell*.....Maestricht, Holland.
Upper Chalk.

268. **Homœosaurus Maximiliani.** *Meyer*.....Kelheim, Bavaria.
Middle Oolite.

270. **Saphæosaurus laticeps.** *Meyer*.....Kelheim, Bavaria.
Middle Oolite.

277. **Sauranodon incisivus**.....Dept. of Ain, France.
Middle Oolite.

278. **Dicynodon lacerticeps.** *Owen*.....Fort Beaufort, Cape Colony.
Trias.

281. **Testudo hemispherica.** *Leidy*.....Mauvaises Terres, Nebraska.
Miocene Tertiary.

285. **Pleurosternon ovatum.** *Owen*.....Swanage, England.
Upper Oolite.

286. **Chelonemys ovata,** (ventral surface.).....Cirin, France.
Middle Oolite.

287. **Chelonemys plana,** (ventral surface.).....Cirin, France.
Middle Oolite.

289. **Hydropelta Meyeri.** *D'Orb*.....Cirin, France.
Middle Oolite.

293. **Labyrinthodon Jægeri.** *Owen*.....Stuttgardt, Wirtemberg.
Keuper (Trias.)

297. **Andrias Scheuchzeri,** *Tschudi*.....Œningen, Switzerland.
Miocene Tertiary.

298. **Andrias Tschudi.** *Meyer*.....Rott, Rhine Valley.
Miocene Tertiary.

225. (C. L.) **Cheirotherium Barthi.** *Kaup*.....Jena, Germany.
Lower Trias (New Red Sandstone.)

299. **Rana diluviana.** *Goldf*.....Bonn, Rhine Valley.
Miocene Tertiary.

302. **Pterodactyle** (restored.).....Kent, England.
Chalk.

303 **Megalosaurus,** (restored.).....Oxfordshire, etc., England.
Oolite.

304. **Iguanodon,** (restored.).....Sussex and Kent, England.
Wealden.

305. **Labyrinthodon,** (restored.).....Cheshire, England.
Trias.

306. **Icthyosaurus,** (restored.).....Somersetshire, etc., England.
Lias.

307. **Plesiosaurus macrocephalus.** *Conyb.* (restored.)...Dorsetshire, etc., England.
Lias.

308. **Plesiosaurus dolichodeirus.** *Conyb.* (Restored.)...Somersetshire, etc., England.
Lias.

PISCES.

309. **Holoptychius nobilissimus.** *Agass*.....Clashbinnie, Scotland.
Old Red Sandstone.

313. **Cephalaspis Lyelli.** *Agass*.....Forfarshire, Scotland.
Old Red Sandstone.

315. Lepidotus maximus. *Wagn*.....Solenhofen, Bavaria.
Upper Oolite.

316. Lepidotus oblongus. *Agass*.....Solenhofen, Bavaria.
Middle Oolite.

317. Lepidotus minor. *Agass*.....Isle of Portland, England.
Upper Oolite.

320. Microdon (Pycnodus) elegans. *Agass*.....Kelheim, Bavaria.
Upper Oolite.

321. Microdon notabilis. *Munst*.....Kelheim, Bavaria.
Middle Oolite.

324. Gyrodus circularis. *Agass*.....Solenhofen, Bavaria.
Upper Oolite.

328. Megalurus lepidotus. *Agass*.....Solenhofen, Bavaria.
Lithographic Slate (Upper Oolite.)

330. Squatina acanthoderma. *Fraas*.....Eichsädt, Bav.
Upper Oolite.

331. Thaumas alifer. *Munst*.....Eichstadt, Bavaria.
Middle Oolite.

338. Carcharodon.....Isle of Malta.
Miocene.

336. Acrodus nobilis. *Agass*.....Lyme-Regis, Eng.
Lias.

338. Plycodus decurrens. *Agass*.....Kent, Eng.
Chalk.

342. Mesturus verrucosus. *Wagner*.....Eichstadt, Bavaria,
Middle Oolite.

344. Ichthyodorulite, (dorsal spine).....Lyme-Regis, Eng.
Lias.

347. Holocentrum pygæum. *Agass*.....Monte Bolca, Italy.
Eocene Tertiary.

1201. Coprolite of Fish.....Kent, Eng.
Lower Chalk.

ARTICULATA.

CRUSTACEA.

353. Enoplocytea Sussexiensis. *Mant.* (claw).....Lewes, England.
Lower Chalk.

354. Eryon propinquus. *Germar*.....Eichstadt, Bavaria.
Upper Oolite.

358. Pemphyx Sueurii. *Meyer*.....Crailsheim, Wirtemberg.
Muschelkalk (Middle Trias.)

365. Limulus Walchii. *Desm*.....Eichstadt, Bavaria.
Middle Oolite.

367. Euripterus lacustris. *Harlan*.....Williamsville, N. Y.
Waterlime Group, (Upper Silurian.)

368. Eurypterus lacustris. *Harlan*.....Williamsville, N. Y.
Waterlime Group, (Upper Silurian.)

372. Pterygotus Anglicus. *Agass*.....Forfarshire, Scotland.
Old Red Sandstone.

373. Asaphus gigas. *Dalm.* (restored from fragments.)..Adams Co. Ohio.
Lower Silurian.

380. Asaphus expansus. *Dalm*.....Motala, Sweden
Lower Silurian.

382. Asaphus tyrannus. *Murch*.....Bishop's Castle, Wales
Llandeilo Flags. (L. Sil.)

384. Asaphus Barrandi. *Hall*.....Platteville, Wis
Trenton limestone, (L. Silurian.)

388. Angelina Sedgwicki. *McCoy*.....Garth, Wales
Lower Silurian.

390. Bumastus Barriensis. *Murch*.....New York
Niagara Group.

393. Bronteus planus. *Barr*.....Beraun, Bohemia
Upper Silurian.

394. Calymene Blumenbachii. *Brongniart*.....Dudley, England
Upper Silurian.

395. Calymene Blumenbachii. *Brong*.....Dudley, England
Upper Silurian.

396. Calymene senaria. *Conrad*.....Cincinnati, Ohio
Lower Silurian.

397. Calymene læviceps. *Dalm*.....Motala, Sweden
Lower Silurian.

398. Ceraurus pleurexanthemus. *Green*. (partially restored.)
Lower Silurian.

399. Ceraurus pleurexanthemus. *Green*.....Ottawa River
Trenton limestone.

400. Chirurus claviger. *Beyr*.....Wesela, Boh
Lower Silurian.

401. Conocephalus Sulzeri. *Schloth*.....Ginetz, Bohemia
Lower Silurian.

402. Cychaspis Chrystyi. *Hall*.....Waldron, Ind
Niagara Group.

405. Dalmania calliteles. *Green*.....York, N. Y
Hamilton Group.

408. Dalmania micrurus. *Green*.....Schoharie county, N. Y
Lower Helderberg.

411. Dalmania nasutus. *Conrad*.....Schoharie county, N. Y
Lower Helderberg.

414. Dalmania selenurus. *Eaton*.....Auburn, N. Y
Upper Helderberg.

415. Dalmania socialis. *Barr*.....Bohemia
Lower Silurian.

417. Dindymene Bohemica. *Barr*.....Rokycan, Bohemia
Lower Silurian.

421. Harpes ungula. *Barr*.....Kronieprus, Bohemia
Upper Silurian.

422. Harpides Grimmi. *Barr*.....Przibram, Bohemia
Lower Silurian.

423. Homalonotus delphinocephalus. *Murch*.....Dudley, England
Upper Silurian.

428. Lichas Boltoni. *Green*.....Lockport, N. Y
Niagara Group.

429. Lichas grandis. *Hall.* (head.).....Schoharie county, N. Y.
Schoharie Grit, (Devonian.)

430. Lichas grandis. *Hall.* (pygidium reversed.)....Schoharie Co., N. Y.
Schoharie Grit, (Devonian.)

433. Ogygia Buchii. *Goldf*.....South Wales.
Lower Silurian.

436. Olenellus Thompsoni. *Hall*.....Georgia, Vt.
Quebec Group, (Lower Silurian.)

437. Paradoxipes Bohemicus. *Bock*.....Ginetz Bohemia.
Lower Silurian.

439. Pradoxides Davidis. *Salter*.....St. Davids, Wales.
Lower Silurian.

442 Phacops cephalotes. *Corda*.....Tetin, Bohemia.
Upper Silurian.

INSECTA.

451. Æchna eximia. *Hagen*.....Solenhofen, Bav.
Lithographic Limestone, (Middle Oolite.)

ANNELIDA.

454. Vermetus gigas. *Biv*.....Asti, Piedmont.
Miocene Tertiary.

455. Tentaculites elongatus. *Hall*.....Schoharie Co. N. Y.
Lower Helderberg.

MOLLUSCA.

CEPHALOPODA.

456. Belemnites Oweni. *Pratt*, (guard).....Christian Malford, England.
Upper Oolite.

457. Belemnites Oweni. *Pratt*.....Christian Malford, England.
Upper Oolite.

458. Belemnites giganteus. *Schloth*.....Ehningen, Wirt.
Lias.

461. Belemnites acuarius. *Schloth*.....Whitby, England.
Lias.

462. Belemnites lateralis. *Phil.* (guard.).....Yorkshire, Eng.
Cretaceous.

463. Belotenthis subcostata. *Munst*.....Holzmaden, Wirt.
Lias.

467. Ammonites armatus. *Sow*.....Charmouth, Eng.
Lias.

468. Ammonites Aon. *Munst*.....St. Cassian, Austria.
Trias.

472. Ammonites Batesi. *Trask*.....Shasta Co., California.
Cretaceous.

473. Ammonites bisulcatus. *Brug*.....Rautenberg, Brunswick.
Lower Lias.

475. Ammonites Blagdeni. *Sow*.....Dorsetshire, England.
Lower Oolite.

487. Ammonites coronatus. *Brug*.....Villere, France
Middle Oolite.

490. Ammonites fimbriatus. *Sow*.....Charmouth, England
Middle Lias.

491. Ammonites fimbriatus. *Sow*.....Charmouth, Eng
Middle Lias.

492. Ammonites gigas. *Zieten*.....Yonne, France
Upper Oolite.

495. Ammonites Goliathus. *D'Orb*.....Dives, France
Middle Oolite.

497. Ammonites Henleyi. *Sow*.....Charmouth, England
Lias.

498. Ammonites Herveyi. *Sow*.....Wilts, England
Middle Oolite.

500. Ammonites heterophyllus. *Sow*.....Reutlingen, Wiltemberg
Lias.

501. Ammonites Humphriesianus. *Sow*.....Yeovil, England
Lower Oolite.

502. Ammonites ——.....Calvados, France
Middle Oolite.

503. Ammonites interruptus. *Brug*.....St. Florentin, France
Cretaceous.

504. Ammonites interruptus, *Park*.....France
Gault (Cretaceous).

505. Ammonites Jason. *Rein*.....Christian Malford, Eng
Middle Oolite.

509. Ammonites linguiferus. *D'Orb*.....Calvados, France.
Lower Oolite.

511. Ammonites macrocephalus. *Schloth*.....Wiltshire, England.
Middle Oolite.

515. Ammonites margaritatus. *Mum*.....Charmouth, Eng.
Lias.

518. Ammonites Millesianus. *D'Orb*.....Rouen, France.
Chalk.

519. Ammonites modiolaris. *Luid*.....Wiltshire, England.
Middle Oolite.

521. Ammonites obtusus. *Sow*.....Charmouth, England.
Lower Lias.

523. Ammonites peramplus. *Mant*.....Germany.
Chalk.

525. Ammonites planicostatus. *Sow*.....Dorset, England.
Lias.

527. Ammonites raricostatus. *Ziet*.....Charmouth, England.
Lias.

529. Ammonites Rhotomagensis. *Brong*.....Rouen, France.
Chalk.

531. Ammonites serpentinus. *Schloth*.....Boll, Wirtemberg.
Lias.

536. Ammonites Woollgari. *Mant*.....Sussex, England.
Chalk.

537. Ammonites Woollgari. *Mant*.....Sussex, England.
(Enlarged from 536.)

538. Ammonites gigas. *Ziet.* (Enlarged from 492.).....Yonne, France.
Upper Oolite.

539. Ancyloceras Andouli. *Astier*.....Cheiron, France.
Cretaceous Greensand.

540. Ancyloceras Emerici, *D'Orb*.....Barreme, France.
Upper Neocomian, (Cretaceous)

541. Ancyloceras gigas. *Sow*.....Atherfield, Isle of Wight.
Cretaceous Greensand.

543. Ancyloceras Tabarelli. *Astier*.....Barreme, France.
Cretaceous.

546. Baculites anceps. *Lam*.....France.
Chalk.

547. Ceratites nodosus. *De Haan*.....Luneville, France.
Muschelkalk, (Trias.)

551. Crioceras bifurcatus. *Quenst*.....Reutlingen, Wirtemberg.
Jurassic.

552. Crioceras Duvalii. *Lev*.....Escragnolles, France.
Neocomian (Cretaceous.)

553. Goniatites expansus. *Vanux*.....Manlius, N. Y.
Goniatite limestone (Devonian.)

554. Goniatites ixion. *Hall*.....Rockford, Ind.
Carboniferous.

555. Hamites attenuatus. *Sow*.....Folkestone, England.
Gault (Cretaceous.)

557. Hamites Astierianus. *D'Orb*.....Barreme, France.
Neocomian (Cretaceous.)

558. Hamites (Hamulina) cinctus.) *D'Orb*.....Barreme, France.
Upper Neocomian (Cretaceous.)

563. Scaphites Ivanii. *Puzos*.....Barreme, France.
Lower Greensand.

564. Scaphites compressus. *Röm*.....Haldem, Westphalia.
Chalk.

566. Toxoceras obliquatum. *D'Orb*.....Escragnolles, France.
Greensand (Cretaceous.)

567. Turrilites costatus. *Lam*.....Rouen, France.
Chalk Marl (Lower Cretaceous.)

569. Nautilus bidorsatus. *Schloth*.....Brunswick, Germany.
Muschelkalk (Trias.)

573. Nautilus Neocomensis. *D'Orb*.....Escragnolles, France.
Neocomian (Cretaceous.)

574. Nautilus pseudo-elegans. *D'Orb*.....Rouen, France.
Chalk.

575. Nautilus semistriatus. *D'Orb*.....Charmouth, Eng.
Lias.

578. Nautilus ——.....Charmouth, Eng.
Middle Lias.

Nautilus ——.....Kentucky.
Carboniferous ?

Lituites undatus. *Conrad*.....Middleville, N. Y.
Black River limestone, (L. Sil.)

Discites ornatus. *Hall*.....Manlius, N. Y.
Goniatite limestone, (Devonian.)

Orthoceras amplicameratum. *Hall*.....Middleville, N. Y.
Trenton Limestone, (Lower Silurian.)

Orthoceras crebrum. *Sæm*.....Eifel, Rhine Valley.
Devonian.

Orthoceras inequale. *Barr*.....Butowitz, Bohemia.
Upper Silurian.

Gomphoceras inflatum. *Quenst*.....Eifel, Rhine Valley.
Devonian.

Phragmoceras subventricosum. *D'A and De V*..Eifel, Rhine Valley.
Devonian.

Cyrtoceras macrostomum. *Hall*.....Mineral Point, Wis.
Trenton Limestone (L. Sil.)

Cyrtoceras corbulatum. *Barr*.....Bohemia.
Upper Silurian.

Cyrtoceras elongatum. *Barr*.....Beraun, Bohemia.
Upper Silurian.

Gyroceras trivolvis. *Conrad*.....Schoharie county, N. Y.
Upper Helderberg, (Devonian.)

Gyroceras expansum. *Sæm*.....Cazenovia, N. Y.
Hamilton Group.

Gyroceras Eifelense. *D'Arch*.....Eifel, Rhine Valley.
Devonian.

GASTEROPODA.

Rostellaria carinata. *Mant*.....Folkestone, England.
Gault. (Cretaceous.)

Pyrula melongena. *Grateloup*.....Saucats, France.
Miocene Tertiary.

Fusus longaevus. *Lam*.....Bracklesham, England.
Eocene Tertiary.

Cerithium giganteum. *Lam*.....Damery, France.
Eocene Tertiary.

Cerithium giganteum. *Lam*, (inner cast).....Vaugirard, France.
Eocene Tertiary.

Cerithium cornucopiæ. *Sow*.....Contentin, France.
Eocene Tertiary.

Euomphalus rugosus. *Sow*.....Dudley, England.
Upper Silurian.

Capulus elegans. *Barr*.....Bohemia.
Upper Silurian.

Capulus robustus. *Barr*.....Zochkow, Bohemia.
Upper Silurian.

Dentalium Noe. *Bon*.....Astezan, Piedmont.
Pliocene Tertiary.

LAMELLIBRANCHIATA.

647. Ostrea frons. *Park*.....Royan, France.
Chalk.

648. Ostrea Santonensis. *D'Orb*.....Royan, France.
Chalk.

650. Gryphæa arcuata. *Lam*.....Semur, France.
Lias.

651. Exogyra columba. *Goldf*.....Boussa, France.
Cretaceous.

652. Exogyra costata. *Morton*.....Perry Co., Alabama.
Cretaceous.

658. Radiolites crateriformis. *D'Orb*.....Royan, France.
Chalk.

660. Sphærulites Bournoni. *Desm*.....Dordonge, France.
Chalk.

661. Sphærulites calceoloides. *Desm*.....Dordogne, France
Chalk.

663. Caprina adversa. *D'Orb*.....Charente, France.
Chalk.

664. Avicula flabella. *Conrad*.....Onondaga Co., N. Y.
Hamilton Group (Devonian.)

670. Pterinea radians. *Conrad*.....Casenovia, N. Y.
Hamilton Group (Devonian.)

671. Posidonia alveata. *Conrad*.....Sherburne, N. Y.
Hamilton Group (Devonian.)

672. Megambona cordiformis. *Hall*.....Onondaga Co., N. Y.
Corniferous Limestone (Devonian.)

675. Hippopodium ponderosum. *Sow*.....Cheltenham, Eng.
Lias.

679. Trigonia costata. *Park*.....Œschingen, Wirt.
Lower Oolite.

683. Modiola plicata. *Sow*.....Rendcomb, Eng.
Oolite.

686. Thracia —— Thebes, Egypt.
Cretaceous.

689. Teredina personata. *Lam*.....Mt. Bernon, France.
Eocene Tertiary.

BRACHIOPODA.

690. Spirifer pinguis. *Sow*.....Dublin, Ireland.
Carboniferous limestone.

696. Spirifer oxypteris. *Buv*.....Carignan, France.
Lias.

706. Terebratula grandis. *Blum*.....Bunde, Westphalia.
Miocene Tertiary.

716. Terebratula intermedia. *Sow*.....Calvados, France.
Lower Oolite.

755. Productus giganteus. *Martin*.....Derbyshire, England.
Carboniferous.

776. Hemicidaris intermedia. *Flem*.....Wiltshire, England.
Oolite.

781. Palaechinus multipora. *Nor. and O.*.....St. Louis, Mo.
St. Louis Limestone (Carboniferous.)

802. Echinobrissus clunicularis. *Blainv*.....Stroud, England.
Lower Oolite.

814. Clypaeaster umbrella. *Agass*.....Sardinia.
Miocene Tertiary.

821. Discoidea cylindrica. *Agass*.....Rouen, France.
Chalk Marl (Cretaceous.)

825. Galerites albo-galerus. *Lam*.....Kent, England.
Upper Chalk.

833. Dictyophyton tuberosum. *Hall*.....Steuben county, N. Y.
Chemung (Upper Devonian.)

842. Hemipneustes radiatus. *Agass*.....Maestricht, Holland.
Upper Chalk.

847. Micraster cor-anguinum *Agass*.....Kent, England.
Chalk.

860. Ophioderma Egertoni. *Broderip*.....Lyme-Regis, England.
Lias.

861. Ophioderma Egertoni. *Brod*.....Lyme-Regis, Eng.
Lias.

863. Solastor Moretonis. *Forbes*.....Gloucestershire, England.
Great Oolite.

898. Apiocrinus Parkinsoni. *Schloth*.....Bradford, Eng.
Great Oolite.

899. Apiocrinus Parkinsoni. *Schloth*.....Bradford, Eng.
Oolite.

901. Apiocrinus Parkinsoni. *Schloth*.....Bradford, Eng.
Oolite.

904. Astrocoma Cirini.....Cirin, France.
Lithographic Limestone (Middle Oolite.)

911. Crotalocrinus rugosus. *Miller*.....Dudley, England.
Upper Silurian.

917. Encrinus liliiformis. *Schloth*.....Brunswick, Germany.
Muschelkalk (Middle Trias.)

918. Encrinus liliiformis. *Schloth*.....Brunswick, Ger.
Muschelkalk, (Trias.)

919. Encrinus liliiformis. *Schloth*.....Brunswick, Ger.
Muschelkalk, (Trias.)

942. Pentacrinus subangularis. *Miller*.....Boll, Wirtemberg.
Lias.

943. Pentacrinus subangularis. *Miller*.....Boll, Wirtemberg.
Lias.

947. Periechocrinus moniliformis. *Miller*.....Dudley, Eng.
Upper Silurian.

953. Platycrinus Sarae. *Hall*.....St. Louis, Mo.
St. Louis Limestone (Carboniferous.)

954. Pterocoma pinnata. *Agass*.....Solenhofen, Bavaria.
Middle Oolite.

ACALEPHAE.

963. Graptolithus octobrachiatus. *Hall.*
Lower Silurian.

PROTOZOA.

RHIZOPODA.

966. Amphistegina vulgaris. *D'Orb*.....Bordeaux, France.
Miocene Tertiary.

968. Fusulina cylindrica. *D'Orb*.....Ohio and Nebraska.
Carboniferous.

999. Cassidulina serrata.....Austria.
Miocene.

1002. Clavulina communis. *D'Orb*.....Nussdorf, Austria.
Pliocene.

1007. Globigerina bulloides. *D'Orb.*
Miocene; Austria.
Pliocene; Italy.
Living; Adriatic.

1015. Proroporus complanatus. *Reuss.*
Gault.

1036. Siderolina calcitrapoides. *Lam.*.....Maestricht, Holland.
Chalk.

1039. Siphonina reticulata. *Reuss*.....Germany.
Miocene.

1043. Textularia conulus. *Reuss.*
Upper Chalk.

1047. Textularia pupoides.....Meudon, France.
Upper Chalk.

1049. Textularia spinulosa. *Reuss*.....Germany.
Miocene Tertiary.

1059. Cristellaria cassis. *Ficht*.....Sienna, Italy.
Pliocene.

1077. Globulina gibba. *D'Orb*.....France and Adriatic Sea.
Tertiary and Living.

1094. Nodosaria inflata. *Reuss.*
Upper Chalk.

1097. Nodosaria oblonga. *Reuss.*
Eocene Tertiary.

1098. Nodosaria radicula. *Lam.*
Gault (Cretaceous.)

1138. Orbitolites macropora. *Lam*.....Maestrict, Holland.
Chalk.

1150. Spirolina cylindrica. *Lam*.....Paris, France.
Eocene Tertiary.

1161. Vertebralina nitida. *D'Orb*.....Grignon, France.
Eocene Tertiary.

PORIFERA.

1164. Amorphospongia ——.....Franklin county, I
Lower Silurian.

1165. Cœloptychium agaricoides. *Goldf*.....Haldem, Westpha
Chalk.

1166. Placoscyphia meandroides. *Leym*.....Kent, Engla
Cretaceous Greensand.

1168. Polypothecia dichotoma. *Ben*.....Warminster, Engla
Cretaceous Greensand.

1172. Scyphia polyommata. *Goldf*.....Streitberg, Wirtembe
Middle Oolite.

1184. Siphonia costata. *Lam*.....Warminster, Engla
Cretaceous Greensand.

1177. Siphonia pyriformis. *Goldf*.....Blackdown, Engla
Upper Greensand (Cretaceous.)

1185. Tentriculites ——.....Birdlington, Engla
Chalk.

MISCELLANEOUS.

1204. Cycadoides megalophylla. *Buckl.* (Trunk of a short cycad. I
of Portland, Engla
Wealden.

1206. Dammarites ——, (conifer.).....Burton, Somerset, Engla
Inferior Oolite.

1207. Nipadites Burtini. *Brong*.....Schaerbeck, Belgit
Eocene Tertiary.

1212. Welcome Nugget (gold).....Ballarat, Austra

1216. Platinum Nugget.....Ural Mts., Sibe

1237. Rosetta Stone.....Rosetta, Lower Egy

1245. Bust of Linnæus, life size.

1247. Bust of Cuvier, life size.

1248. Bust of Geoffroy St. Hilaire, life size.

Bust of Huxley, life size.

ANNUAL REPORT

OF

THE BOARD OF REGENTS

OF THE

UNIVERSITY OF MINNESOTA

TO THE GOVERNOR,

FOR THE

FISCAL YEAR ENDING NOVEMBER 30, 1876.

TRANSMITTED TO THE LEGISLATURE OF THE NINETEENTH ANNUAL SESSION, 1877.

SAINT PAUL:
THE PIONEER PRESS COMPANY.
1877.

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December, 27th, 1876.

ohn S. Pillsbury, Governor of Minnesota:

nce with the law, I have the honor to forward
al report of the Board of Regents of the
esota, for the university year, ending June
ancial statement of same for the current fiscal
nor to be

Your Obedient Servant,

HENRY H. SIBLEY,

President of the Board of Regents.

THE BOARD OF REGENTS.

The Hon. PARIS GIBSON, M. A., Minneapolis.....1877.
The Hon. MORRIS LAMPREY, M. A., St. Paul.....1877.
The Hon. RICHARD CHUTE, Minneapolis.....1877.
The Hon. WILLIAM R. MARSHALL, St. Paul.....1878.
The Hon. A. A. HARWOOD, Austin.....1878.
The Hon. HENRY H. SIBLEY, St. Paul.....1879.
The Hon. THOS. S. BUCKHAM, M. A., Faribault.....1879.

And ex officiis,

The Governor of the State,
The Hon. JOHN S. PILLSBURY, Minneapolis.
The State Superintendent of Public Instruction,
The Hon. D. BURT, M. A., St. Paul.
The President of the University,
WILLIAM W. FOLWELL, M. A., Minneapolis.

OFFICERS OF THE BOARD.

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Assistant Professor of Latin.

CHARLES Y. LACY, B. Agr.,
Assistant Professor in charge, of Theory and Practice of Agriculture.

LOUIS W. PECK,
Instructor in Physics and Drawing.

Mr. John C. Hutchinson of the Senior Class gave instruction in the department of Greek.

The following gentlemen were employed in the several capacities indicated:

Mr. Wm. T. Scott, Farm Superintendent;
Mr. John S. Clarke, 1st Assistant Librarian;
Mr. Graham C. Campbell, 2d Assistant Librarian;
Mr. Clarke Stewart, Assistant in the Chemical Laboratory;
Mr. J. Clarence Bryant, Janitor of Main Building;

Mr. Stewart instructed a class in Elementary Astronomy in the third term to the satisfaction of the professor in charge.

OFFICIAL CHANGES.

During the year the following changes took place in he Board of Regents and the Faculty:

At the annual meeting in December last the Hon. John S. Pillsbury resigned the presidency of the Board of Regents which he had held continuously since the year 1864. This vacancy was filled by the unanimous choice, of his colleagues, of the Hon. Henry H. Sibley whose connection with the present Board dates from the re-organization of the University in 1868.

During the session of the Legislature the following appointments of Regents were made by the Governor, by and with the advice and consent of the Senate;

The Hon. H. H. Sibley, to fill his own vacancy caused by the expiration of a previous term;

The Hon. Thos. S. Buckham, of Faribault, to fill the vacancy aused by the retirement of the Hon. Chas. S. Bryant at the close f his second term;

The Hon. Richard Chute, to fill the vacancy caused by the ccession of the Regent Pillsbury to the governorship of the tate, the governor being under the organic law a regent *ex-officio*.

At the annual election held on the 10th day of May, 1876, ssistant Professor Richard W. Laing, LL. D., was raised to the ank of professor, and the title of the chair occupied by Professor ohn G. Moore was changed from "German Lauguage and Literture" to "North European Languages."

The professorship of Military Science and Tactics remained acant through the year, notwithstanding efforts of the officers f the Board of Regents seconded by those of Senator McMillan o secure the detail of an officer by the War Department. The acancy has however since been filled by the appointment of First ieutenant John A. Lundeen of the Fourth U. S. Artilery, a raduate of the U. S. Military Academy and an appointee from ur own state.

During the past year the ranks of the corps of instruction ere, for the first time, broken by death. On the 18th day of ay, 1876, after a brief illness, Versal J. Walker, professor of he Latin language and literature, was suddenly taken out of this orld. The University attended his funeral two days later, in a ody. Addresses were made upon this occasion by the State uperintendent and by members of the Faculty. These addresses, ogether with a biographical sketch of the deceased, have been rinted in a "memorial pamphlet" by a committee of the eneral Faculty.

Professor Walker came to the University with the prestige of any years successful work as a teacher and superintendent at he beginning of college work in the University in 1869. His areer as a professor only added to his former reputation, and eightened the esteem in which he had been held by all who knew im, whether as teacher or man. The best part of his life was iven to educational work in Minnesota; his death was a great oss to the University and the State at large—and is keenly felt y the Faculty and students.

GRADUATES.

At the Commencement in June last, twelve degrees were conerred on ten graduates. Nine young gentlemen and one young

lady—making the whole number of graduates twenty-one, two being ladies.

These exercises were very interesting, the large University Hall being too small to accommodate the crowd in attendance.

General George Sykes, U. S. A., commanding Fort Snelling, detailed the Post Band to furnish music for the occasion, sending his Adjutant, Lieut. W. H. Ludlow, to represent him. The bearing and attainments of the graduating class furnished good evidence of the thorough and faithful training given by the Faculty.

ATTENDANCE.

The following tables show the attendance for the year (1875-6.)

SUMMARY—1875-6.

COLLEGE OR DEPARTMENT.	CLASS.	GENTLEMEN.	LADIES.	TOTALS.	
Science, Literature and the Arts	Graduates	5		5	
	Senior	8	1	9	
	Junior	16	4	20	34
Mechanic Arts	Senior	3		3	
	Junior	1		1	
	Special	1		1	5
Agriculture, Advanced Course	Junior	1		1	
Agriculture, Elementary Course	III and IV	2		2	3
Collegiate Department	First	24	6	30	
	Second	32	16	48	78
	Third	31	11	42	
	Fourth	49	20	69	
	Special	22	13	35	167
Totals		196	71		267

OR BY CLASSES ONLY,

Graduates		5
Seniors—of all Departments		12
Juniors—of all Departments		23
Sophomores—First Class, Collegiate Department		30
Freshmen—Second Class, Collegiate Department		48–117
Preparatory, Third Class, Collegiate Department		43
Preparatory, Fourth Class, Collegiate Department		69
Special 87, Elementary Agriculture, 2		89–150
Total		267

BUILDINGS.

The University buildings at present are ample to accommodate the teachers and students for all class recitations, but the growing

emands of the work will soon require the erection of a separate all for a Library and Museum.

A drill room and gymnasium is greatly needed now, and the ork of the able Military professor cannot be carried on in the inter and spring months with any fair degree of satisfaction ithout suitable quarters. A hall costing from $4,000 to $5,000 ould answer the purpose, and it should be erected at once.

The Agricultural College building is satisfactory in all respects -it affords ample class, lecture and collection rooms for the pro- ssors of agriculture and chemistry, with a plant house in the ast wing and a chemical laboratory in the west wing, the latter eing supplied with all needful appliances for making analyses of bjects collected by the geological survey, the agricultural depart- ient, or by private parties ; it is in daily use during the year for nstruction or analysis. The plant house is now fairly started.

LIBRARY.

Over ten thousand bound volumes are catalogued and are freely sed by students and professors. No material additions can be ade for want of funds. The Board has been able to spend but 500 per annum for the purchase of books, while $2,000 could be rofitably used, as many departments of instruction are embar- assed for want of them.

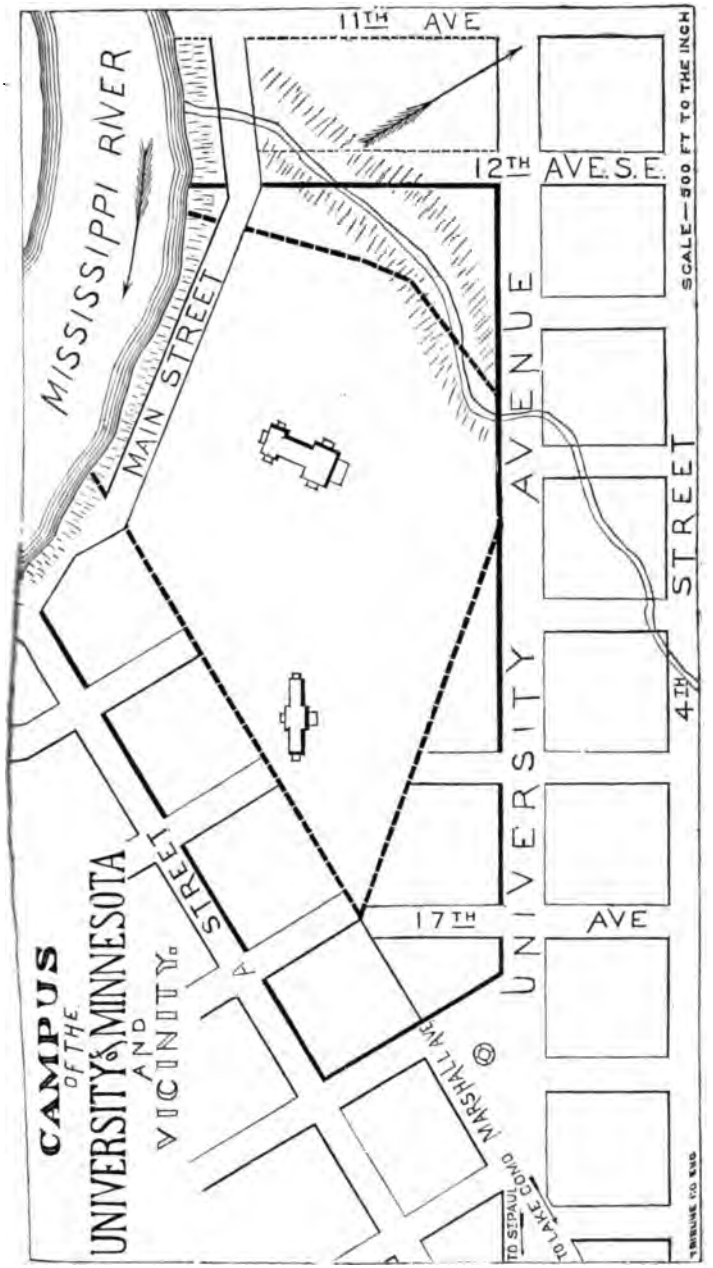
MUSEUM.

The year has been one of special activity in the Museum. Be- ides the display of the casts of fossils purchased of Prof. H. A. Vard, and the mammals obtained in the Custer Expedition to the Black Hills, in 1874, the invertebrates purchased of H. P. Wood- an in 1872 has been examined, labeled and placed on exhibition Considerable collections of plants have been made, including some ungi ; about a hundred species of birds have been prepared for ounting, and several hundred specimens, illustrating the paleon- ology of the Trenton limestone, have been named, and await the onstruction of cases for exhibition. At the close of the Centennial Exhibition at Philadelphia, seven (7) boxes of ores and minerals ere obtained by the Curator, from the various exhibits, mostly y donation, and have already been safely deposited in the storage

room in the basement of the University, where, along with more than forty other similar boxes and cases, they also await the construction of cases for their exhibition. In addition to these, a purchase was made at Hoboken, N. J., of a fine general collection of mineral species, with many duplicates, specially intended to illustrate the science of mineralogy. These consist very largely of crystalline forms. This collection will embrace at least 15 boxes in addition to those already enumerated.

UNIVERSITY CAMPUS.

By reference to the accompanying map it will be seen that the frontage of the grounds on University Avenue is limited to about twelve rods, while on the upper and lower sides it is completely cut off from streets by abutting private property. These considerations, together with the fact that the grounds in their present irregular shape are too limited for the erection of such buildings as the future wants of the University of a great State will require, and that for sanitary and mechanical reasons it is very desirable to control the waters of the spring brook now touching the campus, impelled the Board to commence proceedings in the Hennepin county District Court, under the law of the State, for the condemnation of sufficient lands to square out the grounds between 12th Avenue S. E., University Avenue and A. Street. The owners of the property have made no opposition to these proceedings, and generally manifest a disposition to take a fair valuation for their property; a recommendation is respectfully made that you request the Legislature to make an appropriation to pay therefor.


CAMPUS
OF THE
UNIVERSITY OF MINNESOTA
AND
VICINITY
MISSISSIPPI RIVER
MAIN STREET
11TH AVE
12TH AVE S.E.
UNIVERSITY AVENUE
STREET
4TH
17TH AVE
MARSHALL AVE
TO ST PAUL
TO LAKE COMO
SCALE—500 FT TO THE INCH

GEOLOGICAL SURVEY.

The work in the field was confined to Houston and Hennepin counties; the detailed report of the State Geologist is transmitted with the usual colored geological maps. The chemical report of Prof. Peckham accompanies that of Prof. Winchell, and contains analysis of lignites, peats, and mineral waters. The entomological report of Mr. Whitman gives facts as to the distribution of the grasshopper at present in this State; shows its former and late ravages, and furnishes much valuable data as to its habits and the proper means of combatting it in the future. This insect scourge is one that demands immediate and most thorough methods of dealing, and the State would do well to make a suitable appropriation to carry on this branch of the work under the general law. Dr. P. L. Hatch, of Minneapolis, has been appointed State Entomologist.

PREPARATORY INSTRUCTION.

New and sparsely settled States, desiring to give free education alike to all, must, through the appliances of their Universities, do more or less preparatory work.

One hundred and eighteen northwestern colleges report themselves to the Bureau of Education as teaching 37 per cent. of their students in proper college studies, and the remaining 63 per cent. in preparatory branches. Only 8 of these 118 colleges and universities of nine States report no preparatory students. In this number (8,) are included four (4) of the thirty-two (32) Ohio colleges. All the colleges of Illinois, Indiana, Nebraska and Wisconsin, without exception, instruct preparatory students. Of the remaining States of the Northwest, Iowa, Kansas, Michigan and Missouri, but one college in each *reports* no preparatory students. Of all the State Universities of the Northwest, that of Michigan alone has wholly discontinued preparatory work.

But it is desirable that as speedily as possible this be relegated to the high schools, where it properly belongs, hence on the 10th day of May last the Board of Regents adopted the following preambles and resolutions:

WHEREAS, The colleges and universities of the Northern States of the Mississippi Valley are, as a general rule, obliged to carry on preparatory classes or departments, and only one State University—that of Michigan—has, under favorable circumstances, been able wholly to dispense with preparatory work; and

WHEREAS, The high schools and academies of the State generally have

not as yet been developed so far and in such a manner as to offer suitable preparatory training to the youth of the State desiring to enter the University; and

WHEREAS, The Legislature has not yet made any provision by law for the encouragement of preparatory schools in our State; and

WHEREAS, A premature discontinuance of elementary instruction would be detrimental to that high grade of scholarship toward which the Board of Regents desire the University steadily to advance; therefore

Resolved, That the time heretofore named for the discontinuance of the fourth class of the collegiate department be, and the same hereby is, extended until further notice by this Board.

Resolved further, That in order to encourage preparatory work in the high schools and academies of the State, and co-operation by them with the University, no applicant shall be admitted to the collegiate department, to pursue the studies of any regular class or course, who is entitled to receive, and can actually receive, the same instruction in substance in the public schools of the school district in which he legally resides.

Thus the high schools of the cities, by adopting a proper curriculum, will be enabled to articulate with the University, leaving its doors still open to the sons and daughters of our farmers and others who have no such advantages—and giving *to all* a place where they may of *right* attend and fit themselves for college work.

AGRICULTURAL COLLEGE AND FARM.

Instruction in this college has been continued as heretofore, a few persons applying for the same. The library and museum of agriculture remain about the same as at the last report. But little planting has been done in the fruit garden and orchard, but numerous observations and some experiments have been made on the planting done last year. As usual, a large number of experiments with garden vegetables and farm crops have been carried on. Considerable quantities of hay, oats, corn and potatoes have been produced. Some improvements, in the way of planting and ditching, have been made. The plant house has been furnished with floor, heating apparatus and staging and a large number of plants collected. For further facts reference is respectfully made to the report of Assistant Prof. Lacy, in which attention is called, particularly to the recommendations concerning the lecture course for farmers.

RESOURCES OF THE UNIVERSITY.

These consist of lands granted by Congress for the endowment of an University, and those granted to the State under the act of

The State Auditor reports additions to the permanent fund, during the yearly sales of land, as follows:

Acres sold in 1875	3,685.81
Amount of sales	$20,166 79
Principal paid	3,407 40
Principal unpaid	16,759 39
Interest paid	702 06
Average per acre, 1876	5 47
Average per acre, 1875	5 49
Average all sales to date	5 62

And the total amount of accumulations of the Permanent University Fund at the close of the fiscal year, to be $295,813.86, full details of which appear in his annual report.

Herewith, I hand you the Treasurer's financial statement for the current fiscal year, which shows fully in detail all the receipts and expenditures, made up with great care, and the items of which have been fully verified by the auditing committee of the Board of Regents.

GENERAL OUTLOOK.

The University is daily growing in favor with our people and is assuming its proper position amongst like institutions in our country; students are now in attendance from thirty-one counties in this State, and from thirteen states and counties. Public opinion in favor of the co-education of the sexes in this institution is now nearly unanimous—old prejudices have, by its favorable workings, been thoroughly dissipated.

By the extension of a net work of street railroads throughout the University City, and the very liberal concessions made by the company to students, on fares, easy and cheap access is had by them to their homes and boarding places; accommodations can now be had at low prices for all, while many students are enabled to supplement their resources (often scanty) by labor given in exchange for board.

With an enlightened realization of the needs of the State, and generous support on the part of the authorities, Minnesota in her infancy has established an institution for higher education free to all the world, and invites all to participate, in its advantages. Her sons and daughters have now no need to leave its borders to obtain

thorough classical or scientific education, and the hundreds now thronging her University Halls give proof that these advantages are in a good degree appreciated and understood by her people.

OFFICERS OF INSTRUCTION, UNIVERSITY YEAR 1876-7.

WILLIAM W. FOLWELL, M. A., PRESIDENT,
Instructor of Political Economy and Librarian.

G. CAMPBELL, M. A. B. D., VICE-PRESIDENT,
Professor of Mental and Moral Philosophy.

JABEZ BROOKS, M. A. D. D.,
Professor of Greek, and in charge of Latin.

EDWIN J. THOMPSON, M. A.,
Professor of Mathematics and Astronomy.

NEWTON H. WINCHELL, STATE GEOLOGIST,
Professor of Geology and Mineralogy.

CHARLES N. HEWETT, M. D.,
Non-Resident Professor of Public Health.

MITCHELL D. RHAME, M. A.,
Professor of Mechanical and Civil Engineering.

STEPHEN F. PECKHAM, M. A.,
Professor of Chemistry and Physics.

JOHN G. MOORE, B. A.,
Professor of North European Languages.

MOSES MARSTON, M. A.,
Professor of English Language and Literature.

RICHARD W. LAING, LL. D.,
Professor of History and Instructor in Elocution.

MRS. AUGUSTA NORWOOD SMITH,

CHARLES Y. LACY, B. Agr.
Assistant Professor in charge of Theory and Practice of Agriculture.

LOUIS W. PECK,
Instructor in Physics and Drawing.

MR. J. B. CLARK,
Instructor in Latin.

MR. JOHN S. CLARK,
Assistant Librarian and Instructor in Mathematics.

MR. JOHN C. HUTCHINSON,
Instructor in Greek and Latin.

THE UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, MINN.,
December 1st, 1876.

Hon. H. H. Sibley, President of the Board of Regents:

SIR:—I have the honor herewith to transmit the Tenth Annual Report of the condition and progress of the University.

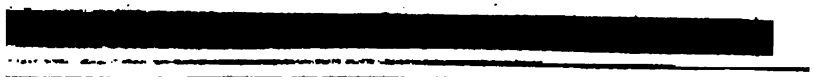
I have the honor to be, Sir,

Very respectfully,

Your obedient servant,

WILLIAM W. FOLWELL,

President.



REPORT OF THE

RESIDENT OF THE UNIVERSITY.

the Honorable the Board of Regents:

he University year 1875–6 began on the 19th day of Septem-, 1875, and ended on the 21st day of June 1876. I would re-ctfully refer you to the CALENDAR for the year for the names residences of the officers and students, and for the usual tine information.

DEATH OF PROFESSOR WALKER.

beg leave to record in this place a brief expression of the sen-ents of myself and colleagues in regard to the sorrowful event ch near the close of the year deprived the Board of Regents of experienced and valued professor, and the Faculty of an es-ned and beloved friend and fellow-laborer. The General Fac-, by a committee, have published a memorial pamphlet, con-ing a biographical sketch of Professor Walker, and the addresses le at his funeral. I would respectfully recommend that an ropriation be made to defray the expense of this publication, to secure a suitable portrait of their lamented officer.

THE WORK OF THE YEAR.

he following table exhibits the work of the several depart its of instruction, in amount and kind. It does not, however, ude the examinations, nor any account of the revision and cor-ion of examination papers:

he first term began September 21st, 1875, and ended December , 1875. The second term began January 4th, 1876, and ended ch 22d, 1876. The third term began April 3d, 1876, and ended e 22d, 1876.

Subjects.	Instructor.	Class.	No. of Exercises	No. of Students.	Term.
MATHEMATICS.					
Algebra	Thompson.	Fourth.	50	65	II.
Algebra, advanced	"	Third.	55	40	III.
Plane Geometry	"	Third.	68	34	I.
Solid Geometry	"	Second.	12	40	I.
Plane Trigonometry	"	"	44	40	I.
Spherical Trigonometry	"	"	44	40	I.
Conic Sections	"	"	30	38	III.
Analytical Geometry	"	First.	52	21	I.
Surveying, in class room	Peck.	Second.	24	32	III.
Surveying, in field, by sections	Peck.	Second.	56	6 or 7	III.
Differential Calculus	Thompson.	Junior.	61	4	I.
Integral Calculus	"	"	50	4	II.
Modern Geometry	"	"	40	4	III.
Gen. Theory of Equations	"	"	20	4	III.
Elementary Astronomy	C. Stewart.	Fourth.	50	9	III.
Descriptive Astronomy	Thompson.	First.	50	26	II.
Practical Astronomy	"	Senior.	40	4	I.
CHEMISTRY.					
Agricultural Chemistry	Peckham.	Junior.	57	2	I.
Qualitative Analysis	"	First.	53	16	I.
" "	"	Junior.	53	5	I.
" "	"	Senior,	53	3 (27)	I.
" "	"	Graduates.	53	3	I.
Quantitative Analysis	"	First.	57	1	II.
" "	"	Junior.	57	5 (8)	II.
" "	"	Graduates.	57	2	II.
" "	"	Junior.	54	4 (7)	III.
" "	"	Graduates.	54	3	III.
General Chemistry	"	Second.	57	48	II.
Applied Chemistry	"	Second.	54	20	III.
PHYSICS.					
Mechanical Physics	Rhame.	First.	60	18	I.
Molecular Physics	Peck.	Second.	60	43	I.
Natural Philosophy	Peck.	Third.	60	27	I.
Natural Philosophy	Peck.	Fourth.	56	20	II.
GEOLOGY.					
Historical Geology	Winchell.	Junior.	56	4	III.
Historical Geology Lectures	"	Junior.	4	4	III.
Dynamical Geology	"	Third.	60	46	II.
Mineralogy and Blowpipe Analysis	"	Junior.	55d.h.	3	II.
BOTANY.					
Structural Botany	Winchell.	Third.	28	39	III.
Systematic Botany	"	Third.	28	28	III.
ZOOLOGY.					
Elements	Winchell.	Second.	58	4	II.
Elements	Lacy.	First.	56	7	III.
PHYSICAL GEOGRAPHY.	Lacy.	Fourth.	60	37	I.
ENGLISH, &c.					
English Literature	Marston.	Junior.	60	20	I.
" "	"	"	22	15	II.
" "	"	"	23	11	III
Elements of Criticism	Laing.	Senior.	37	9	I.
Constitution, United States	"	"	40	10	II.
Constitution, Minnesota	"	"	10	10	II.
Logic	Marston.	First.	56	34	I
Rhetoric	"	"	50	22	III.
Anglo-Saxon	"	Second.	60	10	I.
English Words	"	Fourth.	55	37	II.
Prose Composition	Laing.	" 2 §§.	55	67	I.
Rhetorical Exercises, (public)	Marston.	Senior.	70	10	I. II. III
Rehearsals	"	Sen. and Jun.	250	30	I. II. III.

r.	Class.	No. of Exercises	No. of Students.	Term.
	" "	230	30	I. II. III
	Junior.	20	20	I.
	"	55	18	II. III.
	First	30	34	I. II. II
	"	270	34	I. II. II
	"	300	34	I. II. II
	2d, 3d and 4th.	1594	292	I. II.
	2d and 4th.	141	104	I. II.
	" "	14		II.
	2d, 3d and 4th.	647	292	I. II.
	Fourth.	55	33	I.
	"	52	53	III.
	Third.	95	9	II. III.
	Junior & 3d.	60	31	I.
	Second.	61	14	I.
	2d & Jun.	61	21	I.
	Junior & 3d.	34	25	II.
	Second.	56	25	II.
	Sen. & Jun.	85	15	II.
	Second.	54	16	III.
	Junior & 3d.	33	21	III.
	Sen. & Jun.	33	12	III.
	First.	65	34	I.
	Junior.	55	3	II.
	"	55	5	III.
	Sen. Jun. &c.	61	8	I.
	First.	54	20	II.
	"	51	6	III.
	Senior.	56	5	I.
	"	14	4	I.
	Junior.	40	8	III.
	Junior.	56	14	II.
	First.	56	11	II.
	Second.	112	27	II. III
	Third.	56	18	III.
	"	60	13	I.
	Second.		27	II. III.
	Junior.		8	III.
	Third.		18	
1.	"	56	34	II.
	Fourth.	60	84	III.
	"	136	34	I. II.
	"	190	39	I. II. III
	3d & 4th.			I. II. III
	Senior.	55	4	II.
	"	4	4	II.
	Junior.	59	10	I.
	"	30	10	I.
	"	13	10	III.
	"	13	10	III.
	First.	55	7	II.
	"	15	7	II.
	"	53	7	III.
	Second.	60	13	I.
	"	39	13	I.
	"	55	13	II.
	"	17	13	I. II.
	"	55	13	III.
	"	8	13	III.
	Third.	60	10	I.
	"	871	10	I.
H.)	"	99	10	II.
1.)	Fourth.	001	19	I. II. III

Subjects.	Instructor.	Class.	No. of Exercises	No. of Students.	Term.
PHILOLOGY (Theoretical).....	Campbell.	Junior.	24	18	II.
MENT. AND MOR. PHILOSOPHY.					
History of Philosophy	Campbell.	Senior.	40	11	I.
Ontology.....	"	"	25	11	I.
Ethics.....	"	"	40	10	II.
Evidences of Christianity.....	"	"	15	10	II.
Psychology.....	"	Junior.	55	17	III.
Natural Theology.....	"	Senior.	12	8	III.
HISTORY OF CIVILIZATION.....	Folwell.	Junior.	34	22	II.
POLITICAL ECONOMY.					
Lectures.....	Folwell.	Senior.	8	11	I.
Lectures.....	Folwell.	Senior.	45	10	III.
SANITARY SCIENCE.					
					III.
Lectures on Public Hygiene...	Hewitt.	Senior.	6	10	III.
Physiology	Peck.	Fourth.	56	32	
INDUSTRIAL DRAWING.					
Free Hand Drawing	Rhame.	Fourth.	55	23	III.
Plane Problems.....	"	Third.	55	42	II.
Projection and Isometric.....	Peck.	Second.	55	25	II.
Descriptive Geometry.....	Rhame.	First.	55	13	II.
Descriptive and Perspective..	"	"	55	12	III.
Mechanical Drawing	"	Special.	55	1	III.
CIVIL ENGINEERING, &C.					
Applied Mechanics.....	Rhame.	Senior.	60	2	I.
Railroad Work	"	"	40	2	I.
Stereotomy.....	"	"	55	2	II.
Bridge Building.	"	"	55	3	II.
Building Materials.....	"	"	30	3	III.
Applied Mechanics (steam)...	"	"	33	2	III
AGRICULTURE.					
Botany and Landscape Gardening, Lectures.....	Lacy.	Junior.	61	2	I.
Horticulture, Lectures.....	Lacy.	Junior.	56	3	II.
MILITARY SCIENCE.					
(Vacant.)					

NOTES :—(1.) The exercises in Analytical Chemistry, Blowpipe Analysis, Field Surveying and Drawing, occupied double hours.

(2.) Professor Lacy makes no report in this place of time spent in out-door instruction and in conducting labor and experiments on the experimental farm.

GRADUATIONS.

At the fourth annual commencement, held in the Assembly Hall on the 22nd day of June, 1876, the following degrees were, upon recommendation of faculties, by your authority duly conferred:

COLLEGE OF SCIENCE, LITERATURE AND THE ARTS.

Bachelors in Arts.

John Sinclair Clarke.....	St. Mary's N.
John Corrin Hutchinson.....	Hastings.
William Edwin Leonard.....	Minneapolis.
John Aiken Sweat.....	Brownfield, Me.

Bachelors in Science.

Martha Appleton Butler	Franklin, Mo.
Robert Henry Crafts	Minneapolis.
Lewis Singer Gillette	Niles, Mich.
Eugene Alvin Hendrickson	St. Paul.
William Herod Locke	Minnetonka.

COLLEGE OF MECHANIC ARTS,

Bachelors in Civil Engineering.

Lewis Singer Gillette	Niles, Mich.
Eugene Alvin Hendrickson	St. Paul.
Charles Edward Thayer	Minneapolis.

A short address to the candidates is respectfully submitted as part of this report [Appendix A].

ATTENDANCE.

The following tables show the enrollment and classification of students in the various departments or colleges for the year (1875-6.)

COLLEGE OR DEPARTMENT.	CLASS.	GENTLEMEN.	LADIES.	TOTALS.
Science, Literature and the Arts	Graduates	5		5
	Senior	8	1	9
	Junior	16	4	20— 34
Mechanic Arts	Senior	3		3
	Junior	1		1
	Special	1		1— 5
Agriculture, Advanced Course	Junior	1		1
Agriculture, Elementary Course	III and IV	2		2— 3
Collegiate Department	First	24	6	30
	Second	32	16	48— 78
	Third	31	11	42
	Fourth	49	20	69
	Special	23	13	36—147
Totals		196	71	267

OR BY CLASSES ONLY,

Graduates	5
Seniors—of all Departments	12
Juniors—of all Departments	22
Sophomores—First Class, Collegiate Department	30
Freshmen—Second Class, Collegiate Department	48—117
Preparatory, Third Class, Collegiate Department	42
Preparatory, Fourth Class, Collegiate Department	69
Special 37, Elementary Agriculture, 2	39—150
Total	267

COLLEGE OF SCIENCE, LITERATURE AND THE ARTS.

CLASS.	COURSE.	GENTLEMEN	LADIES.	TOTAL.
GRADUATES		5		5 — 5
SENIOR	Classical	4		4
	Scientific	3	1	4
	Modern	1		1 — 9
JUNIOR	Classical	10		10
	Scientific	6		6
	Modern		4	4 — 20
Totals		29	5	34

COLLEGE OF THE MECHANIC ARTS.

CLASS.	COURSE.	GENTLEMEN	LADIES.	TOTAL.
SENIOR	Civil Engineering	3		3
JUNIOR	Architecture	1		1
	Special	1		1
Totals		5		5

COLLEGE OF AGRICULTURE.

Advanced Course, Junior Class, Gentlemen 1
Elementary Course, Gentlemen 3
Total 3

COLLEGIATE DEPARTMENT.

CLASS.	COURSE.	Gentlemen.	Ladies.	Total.
.....	Classical	10	0	10
	Scientific.....	13	3	16
	Modern.....	1	3	4
		24	6	30
.....	Classical	12	1	13
	Scientific.....	16	11	27
	Modern.....	4	4	8
		32	16	48
.	Classical	8	1	9
	Scientific.....	20	6	26
	Modern.....	3	4	7
		31	11	42
.....	Classical	15	0	15
	Scientific.....	29	6	35
	Modern	5	14	19
		49	20	69
TUDENTS.....		28	18	36
		159	66	225

hundred and forty-one (241) students were registered as
ts of Minnesota, the following counties being represented :
ta, 1 ; Becker, 2 ; Blue Earth, 9 ; Brown, 2 ; Carver, 3 ;
; Dakota, 2; Dodge, 1; Douglas, 1; Faribault, 1; Fillmore,
eeborn, 1; Goodhue, 1; Hennepin West, 77; Hennepin
4; Le Sueur, 6; Meeker, 4; Mower, 2; Nicollet, 4; Olm-
Ramsey, 5; Rice, 5; Scott, 1; Sibley, 1; Stearns, 2; Steele,
basha, 10; Washington, 11; Waseca, 1 ; Winona, 8 ;
, 10. 31 counties. Of the students from Hennepin East
nnepin West 26 came from the country, and 20 were tem-
residents of Minneapolis.

ıty-six (26) students were registered from other States and
es, as follows :

ta Ter., 1; Illinois, 1; Iowa, 5; Maine, 3; Michigan, 1;
i, 2; Nova Scotia, 3; New York, 3; Ohio, 1; Pennsylva-
Sandwich Islands, 1; Wisconsin, 4.

ıundred and fourteen (114) students engaged in some remu-
employment, and sixty-nine (69) are believed to have
heir whole living. Fifty-seven (57) had at some time been
.

ADMISSIONS.

rhole number of applicants for admission, during the year,
hundred and thirty, (130,) of whom one hundred and fif-
t

teen (115) were examined on the elementary branches. Of those examined (115) thirty (30) failed, and eighty-five (85) passed.

Of the number not examined (15), one (1) was re-admitted to former standing, four (4) disappeared, and eight (8) were admitted as special students upon informal examinations, most of them being persons of advanced age desiring merely to pursue some specialty.

The average per cents. of merits for the elementary branches were: reading, 80 per cent.; writing, 78 per cent.; spelling, 82 per cent.; English grammar, 65 per cent.; arithmetic, 78 per cent. elementary algebra, 68 per cent.; geography, 68 per cent.; United States history, 60 per cent.

Although this report properly covers the year ending with the last commencement I deem it proper to apprise your honorable body of the effect of the important action had at the meeting of the Board on the 10th day of May last, touching the dropping of preparatory work. The first year of this work was dropped at the close of the University year 1873-4, and there was on record a formal resolution to dispense with that of the second year at the end of the year covered by this report (1875-76.) It is not necessary to recite the considerations which led the Board to reopen the question of dropping this second year. Some of these may be found in the last annual report, others in the able reports both for the present year and the previous one, of the State Superintendent of Public Instruction. The conclusion reached is clearly wise and judicious; the University now offers preparatory instruction to those who need it and can not of right freely obtain it elsewhere, while declining to receive all those who are entitled to receive the same instruction in their own towns or districts. The preparatory instruction thus offered is given in the main by young instructors, working under the the immediate direction of the professors. So long as the State needs to have this work done by the University, in no way can it be done so economically and efficiently.

The new regulation went into effect at the beginning of the year now passing. Contrary to expectation the number of applicants, instead of falling below that of former years, was considerably above them. The large number of applicants of low grade usually presenting themselves from the immediate neighborhood of the University were left to attend the excellent public schools open to them. The great bulk of those admitted to the preparatory classes are from the country and the country villages, being precisely the class intended by the board to be—for a short period it is hoped—thus accommodated.

The action of the board in respect to this matter appears to receive the general approval of those employed in the educational work in the State. There is reason to expect that the courses of study in the high schools will soon be so arranged as to "fit" aspirants to the University in a proper manner and in a reasonable time. But then these schools will, as now, only be FREE to those youth who actually reside within the several districts. Could an appropriation of public funds be made for the purpose of making

them also virtually free to the country boys and girls, by paying their tuition, there would be at length, in fact, what there is now but in name, a complete State system of public instruction. And I should also hope that whenever this may take place, that such of our promising academies, as shall be willing to come within the system, may receive a portion of the public support. I take pleasure in naming the academies at Afton, Wasioja and Caledonia, all of which have arranged courses of studies with reference to the University, and have sent many excellent students.

The resolutions adopted by the Board in the year 1873, authorizing the holding of examinations for entrance at different points in the State, has never gone into practical effect, chiefly for the reason that commencement has fallen so late in the season that the Faculty could not conveniently give their time to them. The change in the distribution of the University year, authorized by the Board in May last, will bring the commencement hereafter not much later than the 1st of June. This will give ample opportunity for holding the proposed examinations. Should the Board decide to leave the resolution referred to in force, the general Faculty will, without doubt, put it into operation at the close of the year now passing. I know of no means so likely to bring the University into healthful contact with the schools, and to encourage and stimulate youth to enter upon the higher education.

GENERAL PROGRESS.

The following table shows the progress of the institution so far as regards the number of students and instructors up to date:

Year ending in	No. of Instructors.	No. of College Students.	No. of Preparatory Students.	Total Students.	Remarks.
1868.....	3		72	72	
1869.....	5		146	146	
1870.....	9	18	194	212	Univ. Faculty organized.
1871.....	9	24	221	245	
1872.....	12	27	238	265	New Course of study.
1873.....	13	47	231	278	
1874.....	13	75	212	287	
1875.....	14	90	147	237	Lowest yr. dropped.
1876.....	14	117	150	267	Mil. Prof'p vacant

In regard to the general status and prospects of the institution, I do not think I can do better than to submit for insertion at this point the communication which I had the honor to lay before the board at the meeting of May 10th, 1876.

THE UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, May 9th, 1876.

To the Honorable the Board of Regents:

In the hope that it may be convenient for the board to devote some considerable time at the present meeting to an examination of the condition and wants of the University, I beg leave to submit the accompanying memoranda. * * * * * * * * *

The University has at length fairly assumed her position on College or University ground. At the close of the current year she will count up an even score of graduates.

The buildings, apparatus, library and other appliances are, considering the age of the institution and the State, creditable for extent and usefulness. It would at first sight seem that the board might at length take a respite from the arduous labors incident to the founding and nurture of an infant university. Experience, however, forbids the indulgence of any such expectation. The older and larger the institution, the severer the labors and the heavier the responsibilities of the governing board.

Our university may fairly claim to have made a good beginning. Nearly a thousand young men and women have been under our instruction, and have gone out to the duties of life thankful for the free gift they have received.

We have, however, merely laid a foundation on which to build for the future. There will never be a time in our history when there will not be more instruction called for than we can impart; more buildings and appliances needed than we can afford, and more money demanded than can be accumulated.

It must be remembered that competition operates on public or State Universities as well as upon those controlled by corporations or religious denominations A great revolution is at this time in progress in the higher education of the country. A few great and rich institutions, with their great buildings, libraries and collections, are attracting students by the hundreds from all parts of the country, and even from foreign countries. Traveling is cheap and rapid. The mail and the telegraph make it a matter of comparative indifference whether the college student is one hundred or ten hundred miles away from the paternal roof. As a matter of fact our institution is now actually in competition with Yale and Cornell and Amherst and Michigan. There are students now at those colleges from this State, who have gone there because they secure greater advantages than we can yet offer.

These great universities are using novel and strenuous efforts to attract students from a distance. Harvard University will hold this summer examinations for entrance in Cincinnati, and Yale College in Chicago. It will not be surprising if within five years examiners from Cornell, Harvard and other institutions, will be holding examinations in St. Paul.

The competition will thus be brought to our very doors. It must be met, if at all, in a vigorous, business-like manner. No sentiment nor palaver will be of the least avail.

We must build up and strengthen the University. We must "lengthen her cords and strengthen her stakes." We must enlarge the grounds and improve them. We must add new buildings. We must increase the teaching force. We must fill up the library. We must multiply instruments and means of instruction. Above all and as necessery to all others things, the *revenue* must be constantly augmented.

The argument for the existence of State Universities is, that the people, through the agency of the State, can provide for themselves means and facilities for higher education, better and ampler than any private or corporate agencies can possibly do for them. If the State University does not fulfil this just expectation it ought to be abolished.

It should be added that the wants above indicated, are not wants of the remote future. They are now confronting us. Some of these matters should, if possible, be made the subject of serious consideration before this board adjourns. * * * * * * * *

These remain substantially in the same condition as at the time of the previous report. There seems to be no need of repeating the suggestions therein submitted. I would merely add that the subject might properly form a prominent topic of the annual report of the board, and that the map engraved for the last report might be inserted for the information of the legislature. I should regard the failure to secure the proposed additions as a calamity.

BUILDINGS.

I have the satisfaction of reporting the buildings in good repair, and to say for the student body that the damages resulting from intentional or even accidental injury at their hands is purely nominal. The supply of furniture is still scanty, barely sufficient for the comfortable prosecution of the work. I trust it may not be long before the means can be afforded for making some additions looking to the cultivation of the tastes and their rational gratification. Our professors can teach within any four walls; but no one will deny the propriety of making the class-rooms cheerful and attractive through tasteful ornamentation. Especially ought the rooms devoted to the general use, and most accessible to the public, such as the library, the museum and the reception rooms, to be becomingly furnished and decorated.

In regard to additional buildings, I do not venture in the present condition of affairs in our State, to do more than ask the attention of the board to representations heretofore made, of the need of a drill hall for the department of military science. Until such a building can be provided the University, no matter how competent and efficient the instructor may be, cannot compete with the boys' schools of the State in military tactics. Other buildings, such as a ladies' hall, a dining hall, an astronomical observatory, etc., which would add greatly to the resources and usefulness of the institution may remain in abeyance until the approach of better times, but the drill hall ought to be provided at once. A structure every way suitable ought not to cost over $3,500.

The opening of the street railways of Minneapolis, the pioneer line terminating at the University, has had the effect to bring the institution heretofore isolated and remote, into easy communication with all parts of the city.

EXPERIMENTAL FARM.

The operations and improvements made upon the Experimental Farm are shown in detail in the report of Professor Lacy, herewith submitted. The remarks of that officer upon the desirability of securing additional lands seems to me deserving of immediate attention. In view of the objection, suggested by Professor Lacy, against a location remote from the other University establishments, it seems important that any changes really essential, ought

to be decided upon and consummated, before adjacent lan
by appropriation to other purposes, have got beyond reacl

LIBRARY.

The number of bound volumes added to the Library dur
year was 281. Of this number 155 were purchases, the re
donations. Appendix B. is a complete list of these ad
The following donations have been duly acknowledged o
of the Board of Regents:

LIST OF DONATIONS.

To the Library of the University of Minnesota during t
versity year 1875–6:

C. H. Crane, Asst. Surgeon General U. S. A., Washington:
Circular No. 8, Hygiene of the U. S. Army.
Jones, U. A. N. W., Wyoming, including Yellowstone.

J. H. C. Coffin, Washington:
American Ephemeris and Nautical Almanac, 1875.

Mr. Clark Stewart, Minneapolis:
Nation, unbound, Nos. 467 to 529 inc., June 11, 1874 to Aug.

Regent Pillsbury, Minneapolis:
Eighty Miscellaneous Pamphlets. (9 bound.)

Smithsonian Institution, Washington:
Annual Report Smithsonian Institution, 1873–4.

R. Hale & Co., Chicago:
Geo. W. Dodd, Essay on Horse Shoeing—pamphlet

Prof. R. W. Laing, LL. D., Minneapolis:
Beecher, H. W., Fruit, Flowers and Farming.
Turner, Elements of Chemistry.
Handbook on the Slavery Question.

Prof. G. Campbell, M. A., Minneapolis:
Campbell, G., Elementary Course German Language.

Prof. N. H. Winchell, M. A., Minneapolis:
Geological Survey of Ohio—Geology vol. 1.
" " " " —Paleontology, vol. 1.

Hon. P. Cudmore, Le Sueur:
Cudmore's Constitutional History of the U. S.

Hon. Wm. Windom, U. S. Senator, Winona:
Message and Documents, Abridgment, 1874–5.

U. S. Government, through Departments:

Bartlett, R., The Soldiers' National Cemetery at Gettysburg.
Report of a Reconnoissance to the Black Hills in 1874.
Report of the Commissioner of Education, 1874.
Report of an Expedition up the Yellowstone River, 1875.
Preliminary Report of Exploration of Nebraska and Dakota.
U. S. Cost Survey Report. 1872.
Compendium IX Census, 1870
Astronomical Observations, 1873.
Hayden, U. S. Geological Survey. Wyoming, 1870.
" " " " Montana, 1871.
" " " " Montana, Idaho, Wy., Utah, 1872.
" " " " Colorado, 1873.
" " " " Birds of the N. W., 1874.
" " " " Cape, Cretaceous Vertebrata.
" " " " Lesquereux. " Flora.
Powell, Exploration of the Colorado River, 1869-72.
Patent Office Reports, 1869, vols. I, II, III.
" " " 1870, vols. I, II.
" " " 1871, vols I, II.
Report of Comm. of Land Office 1868-71-72.
Report of Comm. of Indian Affairs, 1861-3-6-7-8-70-71.
Report of Comm. of Pension, 1865-6-7-72-3-4-5. Pamphlets.
Welt Ausstellung, 1873, in Wein, Officieller Gen. Catalog.
Monthly Reports of Dep. of Agriculture.
Report of Chief of Engineers, 1867-70.
" " Topographical Engineers, 1841-8-50-60-61-63.
" " Chief of Engineers, 47-48-50-60-64-66-69.
" " " " Appendix to '66. Certain public works.
Annual Report of Commissioner of Agriculture, 1875.
U. S. Geogr. Survey west of 100 Merid. vol. III, Geology.
1st Session 43d Congress, Journal of House of Representatives.
" " " Executive Documents House of Rep.
" " " Miscellaneous " " "
" " " Reports of Committees House of Rep.
" " " Journal of the Senate.
" " " Executive Doc. of the Senate.
" " " Miscellaneous Doc. of the Senate.
" " " Reports of Committees of the Senate.
" " " Report of the Census, 1870.
" " " Miscellaneous Documents.

Mr. Graham C. Campbell, Minneapolis:

Chambers' Mathematical Tables
" Practical Mathematics.

During the recess between the fall an winter terms the Library was removed from its former place of storage in the old part of the main building to the rooms set apart for it on the first floor of the new addition. These rooms are four in number, situated on the East side of the main corridor, and are assigned as follows: No. 18, 14x16 feet, Librarian's office; No. 20, 22x36 feet, reading room; No. 22, same size, storage of the books; No. 24, storage for pamphlets and working room.

Since the removal, the use of the books by the students has greatly increased. The following table shows the number and kinds of books drawn during the year:

LIST OF BOOKS ISSUED TO STUDENTS DURING THE YEAR 1875-6.

Class.	No.
Biography	147
History	300
Novels	446
Metaphysics	73
Belles Lettres, Prose	186
Belles Lettres, Poetry	143
Ancient Languages and Literature	68
Modern Languages and Literature	64
Natural History and Science	121
Mathematics	31
Travels	111
Political Science	45
Miscellaneous	169
Issued for home reading	1,904
Issued for reading room	1,650
Total	3,554

Hitherto the library has been conducted with very small cost. It has been possible for me as acting Librarian to give a good deal of personal attention, so that the management could be carried along by the employment of student assistants in the routine work. The opening of new and separate apartments for the library, to say nothing of the steady increase of executive duties, render it impracticable to give any consecutive attendance or labor to it. The need of a salaried assistant to have the immediate oversight, to keep the accounts and attend to cataloguing, is imperative. The last named duty is one of great importance. A store of books without catalogues is of little more worth than so many cubic feet of blank paper, or even straw. A small collection of books, with good catalogues, is much more useful than a large one without. The several lists of accessions, which have appeared in the annual reports have been of immense advantage to our students and instructors, by serving as a "Catalogue of Authors." By means of these lists a reader can ascertain in a moment whether any known author is represented by any of his works, and upon what shelf or shelves volumes on hand may be found. This is excellent so far as it goes. When however, a person comes inquiring what books there may be upon a certain subject no answer can be given beyond that which the librarian can venture from his personal memory. To take an example, a student can from our lists of authors ascertain at once, what books of Macaulay or DeFoe, or Isaac Taylor or Carey, or any authors known to him by name, there are and in what places they may be found; but if he desires to know what writings there are upon galvanism, the nebular hypothesis, the Olympic games, or the protective tariff, the library has no information; such information can only be furnished by a "catalogue of subjects." The cost of printing a catalogue of the subjects now embraced in our library would be not less than $500.00. A large amount of copy has already been prepared and the remainder could be got ready with a small outlay

for copying. The question will at once arise, "Is it wise to expend so much upon catalogues while the need of new books is so pressing?" There can be no doubt as to the answer if the general principle regarding the value of catalogues just asserted is sound. Should the Board find it necessary to postpone the printing of the subject catalogue, then the preparation of a copy in manuscript should at once be authorized.

In regard to the increase of the library, I do not deem it necessary to do more than to refer to the representations of previous reports. There is no occasion to argue before this board in behalf of the library as the most prominent and indispensible part of your apparatus of instruction. I would respectfully ask that the question of increasing the annual appropriation be seriously considered at the annual meeting. I would also suggest that some proportion of the funds devoted to the increase of the library should be entrusted directly to the librarian for the purpose of collecting some of the more valuable serial publications, and of "picking up" valuable works needed in the library, as offered in the trade by second-hand dealers.

READING ROOM.

The following is a list of the periodicals supplied to the reading room, those marked with a star having been furnished gratuitously by the publishers.

Quarterlies:—The Journal of Speculative Philosophy, The New Englander, The North American Review, The Edinburgh Review, The British Review, The Westminster Review, The London Review, The International Review, (six times a year.)

Monthlies:—The American Journal of Science and Arts, The American Agriculturalist, The Eclectic Magazine, Appleton's Popular Science Monthly, Scribner's Monthly, Harper's Magazine, Blackwood's Magazine, Van Nostrand's Engineering, The Contemporary Review.

Weeklies:—Littell's Living Age, The Nation, The New York Tribune, The Scientific American, Harper's Weekly, Ueber Land und Meer, The Farmers' Union,* The Prairie Farmer, The Canada Farmer, Official Gazette of the U. S. Patent Office.*

Semi-Weekly:—New York Evening Post *

Daily:—The St. Paul and Minneapolis Pioneer-Pres,* The Minneapolis Tribune,* War Department Weather Map.*

MUSEUM.

This establishment has at length an existence in fact. During the year, a portion of the materials which have been accumulated have been put on exhibition in the room assigned for the purpose. They form a creditable opening. The report of the curator is referred to for details, and a memorandum kindly furnished by Prof. Winchell in advance of his reports, is respectfully placed at the disposal of the board. I share in the satisfaction of the Professor at the development of the scientific work of the institution, and I look to the museum that is or ought to grow up here, to greatly stimulate and extend that development. The museum

is not a mere show, it is an indispensible means of instruction. The sciences properly called "natural," cannot be taught without specimens, any more than the "physical" sciences can be taught without instruments. From written and oral descriptions, and from pictures, the student can learn many things *about* plants, animals, and rocks, etc., but he cannot be said to *know them*, until brought into contact with them through his senses. The museum therefore, as prerequisite to certain scientific study and research demands immediate reinforcement. This cannot be had without labor and money. Some additions can be made by means of exchanges, but those will serve mainly to "sort up." The main body of objects must be bought of the collectors. However in our case the immediate exigency is one requiring an outlay for cases in which to display for study the collections already made. Money is also needed to provide cases for the technological collection making by Professor Peckham for the illustration of applied chemistry, and for the industrial objects and implements which are accumulating in the colleges of agriculture and the mechanic arts.

APPARATUS.

No additions of importance were made during the past year. The departments of physics and civil and mechanical engineering are supplied with the more indispensable instruments, but that of astronomy is destitute of any. The University is indebted to T. B. Walker, Esq., of Minneapolis, for the loan of an excellent telescope of sufficient power and adaptability to enable the professor to illustrate his instruction. A celestial globe is much needed at the present moment.

"COLLEGES OR DEPARTMENTS."

The customary college or academical work of the University is at length well established and organized, and there seems to be no falling off in the demand for the traditional courses of instruction in spite of the adverse criticisms and denunciations of the past few years. In education people are conservative when it comes to action. They are likely to make sure of the good of the past before venturing in the case of their own children upon experiments. This consideration, and the fact that the great body of our students demand the traditional courses, will certainly justify the board in the prominence they have given to the customary classical and scientific studies. The board have simply conformed, as conform they must, to the "law of demand and supply." When the number of students desiring to pursue the technical courses of the colleges for agriculture and the mechanic arts shall have increased so as to form classes of respectable size, the board will be justified in expending more money upon their instruction. There is reason to expect that the revival of public improvements which must follow the general recovery from the late financial depression will, by the demand for engineering skill, fill up our engineering classes again. Trained architects and mechanical engineers will also be

in demand, and if this University shall be able to supply the necessary instructors and means of instruction, some proportion of the aspirants will be attracted hither. In regard to the training of scientific agriculturalists, the outlook is not specially encouraging. The experience of nearly all the institutions offering instruction in this specialty clearly proves that the demand for scientific instruction in agriculture, of a grade equivalent to that imparted to engineers, metallurgists, chemists, &c., in our polytechnic schools is not so great as they are prepared to supply, nor as the industrial interests of the country deserve. The majority of students in this institution have always been farmers' sons and daughters, but they as a body steadily demand the ordinary courses of study. The numbers of students pursuing agriculture as a distinctive and special line in the Universities of the Northwest, as shown by their reports, are very small indeed.

It is greatly to be regretted that the attendance upon the Agricultural Departments of this University is not commensurate with the provision which has been made for it, but the responsibility must rest upon the public and not upon the Board of Control, for their duty in the premises is clearly defined, and has been discharged with particular reference thereto, as well as to the best interests of the State. The profession of Agriculture should not longer neglect to fill up the classes of the college endowed and kept open for its special benefit.

In view of the facts it would be a suitable question for consideration whether so costly a department should be maintained for the benefit of the very few students who resort to it. Most fortunately the framers of the act of Congress, with a clear understanding of the condition of things present and prospective, so guided the legislation as to be sure to secure the beneficial aid aimed at. They legislated broadly for the benefit of the *industrial classes* in the *several pursuits* and *professions* of life," and while emphasizing the duty of teaching those "sciences relating to agriculture and the mechanic arts," they specially provided against the exclusion of "other scientific and classical studies." These liberal and well-considered provisions enable the National Schools of Science founded in pursuance of the act to adapt themselves precisely to the demands of the people. It appearing that general scientific training is what the public now need and exact; they have, without exception, arranged general scientific and classical courses of study, and collected faculties adapted to carry them on. Wherever a serious demand has appeared for technical instruction it has at once been furnished, often times at an expense disproportionate to its comparative importance.

There is one manner in which, in my opion, your honorable body might be justified in adding to the expense, considerable as it now is, of carrying on the College of Agriculture, and that is by establishing the free course of Farmers' Lectures heretofore had under consideration. Professor Lacy strongly recommends this measure. My own views were fully presented in the annual report for 1874. While the first demand of our farmers is the general scientific and classical education of their children, the next

is reliable scientific information upon the numerous practical problems presenting themselves. The Lecture course might supply such information.

The establishment of new colleges, such as those of Medicine and Law, while it must doubtless be postponed, still should be kept in mind. The time spent in waiting may well be given to wise consideration and planning. A great revolution is now taking place in the law and medical colleges of the country. Instead of receiving, as a matter of course, all candidates who may drift to their doors, several institutions are holding examinations, sufficiently rigid to exclude the absolutely illiterate. The Harvard Law School requires a knowledge of Latin or French or German, in addition to a good common school training. These requirements for admission will, undoubtedly, be raised and multiplied, and by the time the revenues of this University are ample enough to warrant the opening of the law or the medical department, it may be feasible to require the candidate for a law or medical degree to present himself with a scholastic preparation equal to that required of architects, engineers and farmers.

PROFESSORSHIPS.

I would respectfully renew my previous recommendation to fill the chairs of Physics and Botany now attached to those of Chemistry and Geology respectively, as soon as may be practicable.

Not less important is the early employment of a specialist to devote his whole time and thought to Rhetoric and Elocution, which subjects are now in charge of the professor of English, by whom, and his colleague, the professor of History, they have been for the past two years efficiently taught. It is, however, highly desirable that those officers be liberated from a great burden of work carried on at the expense of their own proper departments—departments which in these times no University can afford to have placed at a disadvantage. The rhetorical and the elocutionary work requires for their successful performance—trained specialists. The ordinary scholarly professor cannot be expected to turn aside and teach by actual example—and in no other way can they be taught—these forensic arts. Further, the persons engaged in these duties must be free from the hearing of recitations in order to be able to meet the students for criticism and consultation. Without in the least disparaging the other departments of instruction I think that I may safely assert that no other work done in the institution will tell for or against the University so much as the instruction in writing and speaking, and this I say, notwithstanding my private conviction, is that we have a great deal too much of both in our time and country. The wise rhetorician, however, will teach his pupils when to hold their tongues.

GEOLOGICAL SURVEY.

The report of the State Geologist, herewith transmitted, contains the detailed reports on the counties of Houston and Henne-

pin, together with other important scientific information in the departments of Chemistry, Botany, Entomology and Ornithology. The report will commend itself to all who are interested in the development of the resources of our State and in the problems of science presenting themselves in the study of the natural features and life of the region.

I deem it a matter of regret that the scientific corps of the University is not able to perform a much larger part of the work on the survey, and it is partly on account of this reson that additional professors are needed. The Botany and the General Zoology ought, at an early day, to be placed in charge of competent chiefs, holding professorships in the University. In the meantime the arrangements made to secure contributions in outlying specialties should be continued and perhaps extended. I will add that, in my opinion, the University officers engaged upon the work of the survey should be associated in a board or commission under the authority of the Board of Regents. Such an arrangement would harmonize and concentrate the interests and efforts of all concerned.

SECRET SOCIETIES.

I beg leave to refer to paragraphs of the last report upon this topic, and to say that I have the satisfaction of finding myself borne out in my conclusions by the late able and exhaustive report of President Robinson, of Brown University, to the corporation of that institution. The present time does not seem suited to any general or definite action in the matter, but rather to a judicious and temperate agitation having in view the cultivation of a wholesome public sentiment regarding these organizations.

CONCLUSION.

With the period covered by this report closes the seventh year of college work in the University, and the ninth of its actual existence. I trust and believe that upon a review of this short history your honorable body will find much cause to congratulate yourselves and the people in whose behalf you exercise your trusts, as to the result, under Divine Providence, of your unpaid but ungrudged efforts.

And for the future I can renew the pledges of myself and my colleagues of the corps of instruction to labor on with all our powers to carry forward the work you have laid upon us.

All of which is respectfully submitted.

APPENDIX A.

ADDRESS TO THE CANDIDATES FOR GRADUATION AT THE ANNUAL COMMENCEMENT, JUNE 22, 1876, BY THE PRESIDENT OF THE UNIVERSITY.

For several reasons I have excused myself from making any such extended address as is sometimes expected on occasions like this. Whatever might be the interest of our guests, I am sure that any scholastic performance would be quite out of harmony with the present temper and feelings of our little academic community.

A short month ago there fell upon us like a thunder peal from a clear sky, an event* which, by its suddenness, shocked and paralized all. The shadow whcih then dropped down upon us has not been lifted.

I do not mean now to renew the grief of those sad hours during which our work stood still, and which closed with the committal of that honored dust to the grave. We can now at length with composure I trust, look back upon that event and gather up its lessons. There is one of these which I desire for a moment to emphasize, and to commend in particular to these candidates whose academic career is now closing.

There can be no one of our number who has failed to observe and to feel the air and spirit of sobriety which has pervaded this place since the time I mention. There has been a hush and a solemnity attending our most prosaic occupations. Seriousness and thoughtfulness, in an unusual degree, have marked and tinged all our acts and movements. Many a vow of devotion to higher and nobler life has, I doubt not, been registered; and there is no one of us who would not, I am sure, consent with all his heart, that "it is better to go to the house of mourning, than to the house of feasting."

This, then, is the lesson which I would commend to our young friends at this time, that sobriety is at all times most becoming and salutary to men.

It seems to me that one of the great overshadowing evils of our time, especially in American society is frivolousness—habitual, reckless, almost audacious levity in thought, word and deed.

* The death of Professor V. J. Walker, May 18, 1876.

This comes in a great degree in the way of reaction against the excessive austerity of our ancestors, and from the extraordinary accumulations of wealth, the extension of rapid transportation, and the importation of foreign luxuries, customs and sentiments. To "have a good time," seems to be now the greatest happiness, whether of the individual or of the community. Sustained by what appears to be a general sentiment, thousands of our young men give up all high purposes, all noble ambitions and sink into chronic, well-dressed and respectable sensuality. I wish there were just reason to believe that our young women could be wholly excepted from the same animadversion.

It is not, however, the young who are alone to blame. Everywhere there is the same light and volatile spirit, the same desperate clutching after present gratifications, the same apparent weakening of the sense and promonition of immortality. We note on all hands an unwholesome, feverish thurst for amusements. It seems as if we were in danger of turning our very holiest places into play houses, condoning the desecration by filling the Lord's treasury with the receipts of the lottery and the amateur stage.

I look to education, especially to the higher education as one means of correcting this spirit of weak, insipid, unmanly, frivolity, which has taken possession of American society. The natural effect of sound learning is sobering; it cultivates respect, modesty, reverence. The youth whose eyes have been opened to the treasures of the past and the possibilities of the future, to the revelations of science and the maxims of philosophy, is not likely to give up his life to mere play. This is the grandest argument for the higher education, that its aim and object is, by disclosing to men the divine and wonderful things of the soul, the world and of God, to wean them away from the cheap and the transitory, and the frivilous, to the permanent and everlasting. The true scholar is never a trifler; he needs no sport; his work, is itself the most glorious and exhilerating recreation.

To you, young scholars, about to take up the duties of life, I commend these things as worthy, at least, of reflection; they have been much on my mind during these last days. We dismiss you this day, then, not as to a holiday, but as to a new term of arduous, consecrated, and we trust, peaceful service. Go to this work earnestly, modestly, and hopefully.

We dismiss you, we say, to the duties of real life; I beg you at this last moment to be ever mindful of the whole life, and to live and labor for the whole future, rather than the part. Feed and strengthen your faith in immortality. If there is any glory to a man, it is that he can never die. Looking then to the whole life and living ever in full view of the greater part beyond, I know you must live soberly, righteously, and godly in this present life.

Three students sought and received direct instruction in agricu ture during the year 1875–6. Instruction was given in agricu tural chemistry and agricultural chemical analysis by the Profess of Chemistry, while the Assistant Professor of Agriculture ga instruction in agricultural botany, landscape gardening and hort culture. Of these three students one attended the lectures o horticulture as an elective study, another left the University the end of the winter term and the third received permission change his course at the same time.

There appears to be little demand for direct instruction agriculture by those qualified to profit by it. Some desire whose present attainments are insufficient. They need instructio in composition, mathematics, geography and natural philosoph more than in agriculture. Up to a certain point these branche are far more important than any special instruction. Beyond th point it seems self evident that a knowledge of entomolog ornithology, agricultural chemistry, &c., &c., is of more valu to the farmer than a corresponding knowledge of calculus, Gree and Latin. Two things appear to be necessary before our agr cultural colleges can be filled. The sons of farmers must receiv the elementary training necessary to fit them for intelligent cit zenship and useful members of any occupation or profession an then they must realize the superior value of those studies relatin to their chosen profession over those having no direct connectio with it. Meanwhile the requirements of the law, both in lett and spirit, are filled and perhaps more than filled. Large classe receive instruction in physical geography, physiology, botany natural philosophy and general chemistry, sciences related to the art of agriculture more or less closely, while instruction is offered in several sciences still more closely related. In addition to this many students find employment on the experimental farm, where some instruction in practical details is incidentally imparted.

LIBRARY.

Through donations and exchanges 10 reports of agricultural and horticultural societies have been received, increasing the number of these to 112. The following agricultural publications have been received regularly :

Farmer's Union, Prairie Farmer, Scientific Farmer, Progressive Farmer, Canada Farmer, American Agriculturist, National Live Stock Journal, Gardener's Monthly and Horticulturist.

MUSEUM.

The museum of agriculture remains about the same as at last report, only a few lithographs, photographs, colored plates and other specimens having been added. Samples in the straw of the wheat and oats grown on the farm have been saved and may be placed in the museum in the future.

ORCHARD.

No new planting in the orchard has been done this year, but numerous observations and some experiments on the trees already planted have been made. It having become necessary to clear the ground occupied by the Russian apples planted by Col. Robertson several years since, they were transplanted into the present site of the orchard. They have all lived but made only little growth.

NURSERY.

Part of the trees have been moved from their former place near the barn to the north side of the avenue. Over 400 have been sold. Seven hundred and sixty have been set in a belt designed to protect the barn and a portion of the farm. Six hundred and twenty-five silver maple and box elder seedlings have been transplanted. One thousand sugar maple seedlings have been bought and planted. A quantity of elm seed has been planted and has germinated well. It is the design to make constant additions by seeds, cuttings and purchase of trees.

FRUIT GARDEN.

Efforts were made to add several new varieties of small fruits to our collection but did not result in more than partial success. As in the orchard, observations have been made on those which were planted in 1875.

VEGETABLE GARDEN.

Experiments with the different varieties of garden vegetables have been continued on the same plan as in 1875, the object being, in general, to ascertain which are the most desirable for their earliness, productiveness, quality, &c. They embraced in all more

than 225 varieties. Those experiments which yielded results of any importance are given in the following pages:

DWARF BEANS.

Planted in drills on sandy soil May 20th. Land plowed and thorougly harrowed shortly before planting. Manner of planting same as of peas. Fertilizer, bone dust and animal fertilizer, equal parts, sprinkled lightly on the row about the time of coming up.

Early Six Weeks.—Earliest by about three days. Fit for use July 11th, very productive and a good snap bean.

Early Rachel, Early China.—Three days later than Six Weeks, vigorous growers, of fair quality and productive.

Black Wax.—Three days later than Six Weeks, fairly productive, of extra quality. All things considered the best snap bean tried.

White Wax.—About five days later than Six Weeks; bush very small, and sparse bearer; pod small but of excellent quality. All things considered not desirable.

Early Mohawk.—Four days later than Six Weeks; bush medium size and fairly productive; quality fair.

Farly Fejee.—Five days later than Six Weeks; very prolific: a very good snap bean.

Dun Cranberry.—Five or six days later than Six Weeks; bush a vigorous grower and very productive; quality good for snap, and extra for shelling.

Concord Bush.—Four days later than Six Weeks; resembles Concord Pole bean; bush vigorous grower, productive; good for snap and excellent for shelling while green.

Early Valentine.—Medium early; good for snap or shelling.

BEETS.

Seed sown on sandy soil, April 20th. Fertilizer, bone dust and animal fertilizer, equal parts, applied on the row after coming up. Cultivated with cultivator and hoe sufficiently to keep the weeds out.

Early Bassano.—Earliest—fit for use July 12th; flesh white circled with pink; the best very early variety both for market and use, but not equal in quality to Dewing's Early Blood Turnip when mature.

Egyptian.—Nearly as early as Bassano; fit for use July 14th; form rather flat; color deep red; very tender and sweet.

Dewing's Early Blood Turnip.—About 10 days later than Bassano; fit for use July 22d; for both early and late use, the best variety; tender when cooked and of good flavor.

EARLY CABBAGES.

Seed sown in hotbed March 24th; transplanted to light, sandy soil April 21st; land plowed in fall of 1875, and then manured with stable manure spread broadcast. After planting a little bone dust and animal fertilizer were applied around the plants and afterward mixed with the soil in hoeing.

Little Pixie.—Earliest and best to form heads; fit for use July 7th; heads small, but compact and of good quality. Most desirable early cabbage on the list for use or market.

Burnell's King of Dwarfs.—Fit for use July 7th; head half the size of Little Pixie, and compact; sure to head; too small to be profitable.

Early Wakefield.—Five to eight days later than Pixie; heads well; heads large for early cabbage, compact and of good quality.

Early Wyman.—Season about same as Wakefield; heads well; heads not so solid as Wakefield nor so large, but of good quality.

Early Wimigstadt.—Fourteen to seventeen days later than Little Pixie; sure to head; heads of good size, compact, crisp and of good quality; most desirable second early variety.

Early York.—Season between Pixie and Wakefield: heads well, but the season of heading is unusually long: head little larger than Pixie, medium compact, and of fair quality.

Early Ulm Savoy, Little Pixie Savoy and American Savoy.—No satisfactory results obtained. Plants grew well but did not form heads.

The early cabbages were much injured by a striped worm eating the leaves, and the late ones were nearly destroyed by the same insect.

CARROTS.

Seed sown on sandy soil April 21st; fertilizer, bone dust and animal fertilizer, equal parts, applied on row after plants came up.

Early Horn.—Small but of the finest texture and best quality.

Long Orange.—Later than Horn, much larger but not of so good quality.

Large Altringham.—Much like the last.

Danvers.—Of finer texture and better flavor than Orange or Altringham.

White Belgian.—Large and coarse, desirable only for stock.

CAULIFLOWER.

Seed sown in hotbed March 24th; transplanted to a sandy soil May 11th; fertilizer, guano applied broadcast before planting at rate of 300 pounds per acre.

Early Asiatic.—The earliest; heads small but formed freely; flavor good.

Early Paris.—But little later than Asiatic; heads white, large, compact; flavor good.

Extra Early Dwarf Erfurt—Heads small but freely formed; flavor, very good.

Italian New Early Giant.—Heads large, but rather loose and not so freely formed as by Dwarf Erfurt.

Cauliflower prefers rich, moist soil and same varieties would undoubtedly give better results there than recorded above.

CORN.

Planted on sandy or light sandy soils, as nearly alike in all cases, as possible, and yet have the varieties sufficiently separated to prevent mixing. Fertilizer consisted of guano and bone flour, equal parts. A furrow was made with a single shovel plow, a small handful of fertilizer dropped at intervals of about three feet, a little dirt kicked over it, the seed dropped, and covered with a hoe. The cultivation was sufficient to destroy the weeds and was done with cultivator and hoe, finishing by throwing the dirt toward the rows with small plow.

Early Narragansett.—Planted May 16th; fit for use July 20th; earliest of all; stalks medium size, fairly productive; ears medium size; quality good; earliness is its good point. Objectionable on account of red cob.

Early Minnesota.—Planted May 18th; fit for use July 23rd; stalks small, fairly productive; ears small; quality very good; earliness and good quality are its good points.

Extra Early Dwarf.—Planted May 16th; fit for use July 26th; stalks very small, not very productive; ears very small; quality very good; desirable for its quality.

Adams' Early (not sweet corn.)—Planted May 17th; fit for use July 26th; stalks medium size, productive; ears medium size; earliest dent corn; excellent variety for bread.

Early Selected Sweet.—Planted May 19th ; fit for use July 28th; stalks small but very productive ; ears medium size and well filled; quality very good for early corn.

Crosby's Early.—Planted May 19th ; fit for use August 11th ; stalks medium size, fairly productive ; ears medium size ; quality very good for early.

Moore's Early Concord.—Planted May 19th ; fit for use August 15th ; stalks large, fairly productive ; ears large; quality very good for early ; fine either for table use or canning.

Stowell's Evergreen.—Planted May 18th ; fit for use August 21st; stalks large, productive ; ears large; quality very good.

Scott's No. 1 (crossed.)—Planted May 17th ; fit for use August 20th ; stalks large, very productive ; ears and quality same as Stowell's.

Scott's No. 2 (selected.)—Planted May 19th ; fit for use August 21st ; stalks large, very productive ; ears very large ; quality very good.

Marblehead Mammoth.—Planted May 19th ; fit for use August 30th ; stalks large, fairly productive ; ears very long with short kernel; quality good ; valuable for its long season.

Russell's Prolific.—Planted May 24th ; stalks above medium size, fairly productive ; ears medium sized.

Improved Evergreen Broom.—Planted May 17th ; broken about September 15th and cut about September 25th. Good crop of long and good brush.

CUCUMBERS.

Planted on sandy, or light sandy soils, May 22nd. Fertilizer, bone dust and animal fertilizer, equal parts, a small handful, put in the hill under the seed, a little dirt between ; hill elevated about four inches ; gypsum applied after plants came up.

Early Russian.—Earliest by eight days ; vine small, productive; fruit about three inches long and borne in pairs, tender and crisp; of medium quality for table use and excellent for pickling.

White Spine.—Next in earliness to Early Russian and eight days later ; vine medium size, a great bearer ; fruit light green with white prickles, tender and of good flavor ; very desirable for table use.

Early Cluster.—About ten days later than Early Russian, to which it is similar in vine and fruit except that the latter is prickly ; a great bearer.

Long Green.—Late ; vine large, a good bearer ; fruit large, not very good for the table but makes good pickles.

Tailby's Hybrid.—A little later than Long Green ; vine large and a good bearer ; fruit large, tender and crisp, and the best of any on the list for table use ; not tried for pickling.

Russian Netted.—More curious than useful.

Tender and True.—Destroyed by cucumber beetle.

Norbitan Giant, Snake and Swan Neck—Failed to produce results.

EGG PLANTS.

Seed sown in hotbed March 27th ; transplanted to sandy soil May 24th : fertilizer, bone dust and animal fertilizer, equal parts, applied in hill when the plants were set.

Very Early Dwarf.—Earliest, best in quality, and productive.

New York Improved.—A week later than Dwarf ; productive ; fruit of fair size and good quality.

White China.—Late and of delicate growth.

Scarlet China.—Plant tender ; fruit late and inferior but very ornamental.

Black Pekin.—Plant vigorous and productive ; fruit medium early and of good flavor.

Nothing is to be gained by transplanting to open ground too early. The last of May is in general a good time and then the plants should be protected from sun and wind for a week or ten days.

PEAS.

Peas were planted on two different soils at different times. We shall notice:

1. Peas planted on light sandy soil.

Land plowed in autumn of 1875, and well harrowed before planting. On a strip running entirely across the plat, and at right angles to the rows a coat of stable manure was applied soon after plowing. Peas were planted April 19th, about three inches deep, in rows three feet apart. Furrows were opened with a single shovel plow, seed distributed in the bottom with a seed drill, and covered by running the same plow along side the open furrow. Shortly before the peas came up a little guano was sprinkled on and a garden rake run over the rows to mix in the guano and destroy the weeds. The cultivator and shovel plow

with one hoeing completed the cultivation. The results of observations on time of "first picking," "yield," "table quality," "length of picking season" and "size of vine" are given in the table.

II. Peas planted on stiff loam.

Land a stiff loam with considerable vegetable matter. Plowed May 8th and harrowed. Peas planted May 9th in same manner as above. Had no fertilizer. Otherwise treated the same as above. The date of the first picking is given in the last column of the table.

Name.	First Picking.	Yield.	Table Quality.
Early Caractacus	June 14	Good.	Very good.
Kentish Invicta	June 15	Best.	Good.
William, 1st	June 15	Poor.	Fair.
Philadelphia Extra Early	June 15	Poor.	Good.
Extra Early Winship	June 15	Poor.	Good.
Dexter	June 15	Poor.	Fair.
Alpha	June 21	Very good.	Very good.
Nuttings No. 1	June 21	Very good.	Very good.
Early Kent	June 23	Good.	Fair.
Carter's First Crop	June 23	Poor.	Poor.
Tom Thumb	June 23	Poor.	Fair.
McLean's Little Gem	June 24	Poor.	Very good.
McLean's Blue Peter	June 24	Good.	Very good.
Carter's Extra Early Premium Gem	June 25	Poor.	Very good.
McLean's Advancer	June 26	Very good.	Very good.
Dwarf Waterloo Marrow	July 3	Very good.	Good.
Eugenie	July 5	Best.	Very good.
Laxton's Prolific Early Long Pod	July 5	Poor.	Good.
De Grace	July 5	Poor,	Very good.
Princess Royal	July 6	Very good.	Very good.
Napoleon	July 6	Very good.	Very good.
Yorkshire Hero	July 8	Good.	Very good.
McLean's Premier	July 10	Good.	First.
Champion of England	July 10	Poor.	Very good.
Veitch's Perfection			
Dwarf Blue Imperial			
Carter's Surprise			

The hot and dry weather commencing about July 5th, so interfered with the development of the last three varieties on sandy loam, and of the last five on stiff loam, that no correct observations could be made upon them. The same cause did not allow us to make any observations on the stiff loam except the date of first coloring. De Grace was not planted on stiff loam.

The following observations are borne out by the experiments of two years:

Early Caractacus is not only the very earliest but also a good one in other respects.

Kentish Invicta coming from one to five days later, is superior to Caractacus in all respects save earliness.

McLean's Blue Peter, three to ten days later than Caractacus is inferior in all respects.

Coming later than these are so many good ones, as seen by the table, that it is needless to specify.

FALL AND WINTER SQUASHES

Planted on sandy, or light sandy soils. Fertilizer, guano and gypsum, equal parts, applied more with a view to keeping off the beetles than as a fertilizer.

Marblehead.—Planted May 6th; ripe September 1st; vine large and vigorous, and a much better bearer than the Hubbard; should be planted at least twelve feet apart; fruit more regular than the Hubbard in shape; of equally good quality; cooks more evenly, and is of a lighter color. An excellent keeper.

Butman.—Planted May 17th; ripe about ten days later than Marblehead; vine small compared with Hubbard, and not a very good bearer; fruit smaller than the Hubbard, but of the best quality, especially for baking.

Boston Marrow.—Planted May 18th; ripe about the middle of September; vine of medium size, but vigorous and a good bearer; fruit larger than the Hubbard; of dark yellow color, and fine for cooking or for pies; not good for baking nor a good keeper.

Turban.—Planted May 19th; ripe about the middle of September; vine of medium size and a good bearer; fruit of fair size and very good quality. A medium keeper.

Hubbard.—Planted May 16th., ripe September 26th.

Vegetable Marrow,—Planted May 19th; found excellent for pies August 20th, but lost its good qualities after getting ripe; vine medium size but the best bearer; fruit long, cylinderical and of light yellow color.

Mammoth Yellow Chili.—Planted May 19th; ripe October 1st;

vine of medium size; a poor bearer; fruit very large but of inferior quality.

SUMMER SQUASHES.

Two varieties were planted on light sandy soil May 13th.

Yellow Bush Scalloped—Proved the earliest by two weeks, while the

Summer Crookneck—Was of better quality.

TOMATOES.

Seed sown in the hotbed March 27th; transplanted to sandy soil May 15th; land plowed in fall of 1875, and manured with stable manure spread broadcast on the surface. Fertilizer, guano sprinkled around the plants about two weeks after planting, and mixed with the soil in hoeing. Pinching the vines was practiced upon a few vines, but it appeared to stimulate the growth of the vine and make ripening later.

Golden Gage.—Earliest, and also of best flavor; began to ripen August 4th; vine medium size, upright in growth and medium bearer; fruit smooth, of golded yellow color, rather smaller than Canada Victor, and requires careful handling because of tender skin; in flavor, superior to all others.

Conqueror.—Earliest red tomato; began to ripen August 5th; vine vigorous, very prolific; fruit rather above medium size, of excellent flavor, carries well: in way of ripening similar to Victor.

Canada Victor.—Began to ripen August 7th; vine rather small, prolific; fruit below medium size, of fine flavor, and smooth; inclined to crack in wet weather.

General Grant.—Began to ripen August 8th; vine a vigorous grower and extra bearer, fruit full medium size, carries well, of fine flavor and ripens better than any on the list except Excelsior; rather the best tomato tried.

Hathaway's Excelsior.—Began to ripen August 8th; has all the good points of the Grant except that the crop does not ripen so rapidly—the bearing season is longer.

Hubbard's Curled Leaf.—Began to ripen August 12th; has no points of superiority.

Large Smooth Red.—Began to ripen August 16th; much like Excelsior except that it ripens later.

Trophy.—Began to ripen August 20th; the best large late mato: vine large, vigorous and fairly productive; fruit large, irly smooth, very solid, excellent for cooking and sells more pidly in our market than any other late variety.

Paragon, Robert, Arlington and *Charter Oak.*—Began to ripen ugust 20th; no points of superiority observed.
Strawberry, Persian and *Currant.*—Curious on account of their all fruit; no other merit.

Tomato de Laye.—Upright in growth; more ornamental than eful.

FARM EXPERIMENTS.

These also have been conducted on the same plan as in 1875 but ore extensively. Some of these, from causes beyond our control, ere entire failures. Others will be given in a future report when ey may be compared with the results of another season. They ibrace the following: (1) 20 kinds of fertilizers on wheat. (2) o. 1 and No. 3 wheat for seed. (3) thick and thin seeding of ts. (4) 12 varieties of wheat. (5) 8 varieties of oats. (6) 18 nds fertilizers on corn on sandy soil. (7) 18 kinds fertilizers on rn on vegetable loam. (8) 18 kinds fertilizers on potatoes on ndy soil. (9) 18 kinds fertilizers on potatoes on vegetable am. (10) 19 varieties potatoes on sandy soil. (11) 19 varieties tatoes on vegetable loam. (12) 5 varieties field corn.

FARM CROPS.

Land not otherwise occupied has been devoted to ordinary farm ops from which were obtained 134 bushels oats, and hay esti- ated at 50 tons. From the farm experiments there were also tained 20 bushels wheat, 160 bushels corn and 350 bushels tatoes.

IMPROVEMENTS.

Here should be mentioned the planting of a belt containing 860 ees designed to protect the barn and a portion of the farm from vere winds. All spare time of the team has been employed in uling manure from the city. Some ditches have been made ith the expectation of laying tile in them next summer.

PLANT HOUSE.

It gives me great pleasure to report substantial progress here. floor of "asbestine" stone has been laid in cement, a Hitchings ating apparatus put in, staging erected and a sufficient number plants obtained to encourage hopes for the future, if not to ake a very showy appearance at present.

DONATIONS.

The list of donors is not as long this year as last but their gifts have been no less acceptable. The following are some of the more valuable :

Plants, Wyman Elliot, Minneapolis, Minn.

Paradise Apple Tree, John Hart, Winona, Minn.

Framed Picture of Short-horn, H. F. Brown, Minneapolis, Minn.

Picture of Alderney Herd, C. A. De Graff, Janesville, Minn.

Farmer's Union, W. J. Abernethy, Minneapolis, Minn.

Samples for Museum, John Ott, Richmond, Va.

Agricultural Reports, S. D. Fisher, Springfield, Ill.

Discounts on Seeds and Implements, J. J. H. Gregory, R. H. Allen & Co., Jas. Vick, Ruble & Co., Woodville & Co., and others.

Bulletins of the Bussey Institution, Dr. F. H. Storer, Jamaica Plains, Mass.

Live Stock Journal, National Live Stock Journal Company, Chicago, Ill.

REMARKS.

Effort has constantly been made to bring about an intimate connection between this department and the farming interests of the state and to make the farmers of the state acquainted with our spirit, purposes and methods.

The State Grange, Patrons of Husbandry, held a session in Minneapolis in December, 1875, and accepted an invitation to visit the University in a body. At this session also members of the faculty accepted invitations to deliver addresses.

The annual meeting of the State Agricultural Society was held at the Agricultural college and University in February, 1876. A regular programme, prepared by the secretary, was carried out and the proceedings were of an unusually interesting character.

The State Horticultural Society held a summer meeting and exhibition at the Agricultural College in June, 1876. At the same time the ladies of Minneapolis spread on the University grounds a dinner for the members and guests of the Society. All regarded this meeting as highly successful.

The exhibition made by this department at the State Fair far surpassed that made in 1875, and drew from all who witnessed it the most favorable remarks. The credit of this exhibition is due entirely to Mr. Scott.

Respectfully submitted,

CHAS. Y. LACY.

November 27th, 1876.

THE GEOLOGICAL

AND

NATURAL HISTORY SURVEY

OF

MINNESOTA.

THE FIFTH ANNUAL REPORT.

FOR THE YEAR 1876.

OFFICERS OF THE SURVEY:

N. H. WINCHELL, STATE GEOLOGIST.....In charge.
S. F. PECKHAM.....Chemistry.
M. D. RHAME.....Topography.
P. L. HATCH.....Ornithology.
ALLEN WHITMAN.....Entomology.
CLARENCE HERRICK.....Laboratory Assistant.

SUBMITTED TO THE PRESIDENT OF THE UNIVERSITY, DEC. 31, 1876.

SAINT PAUL:
PIONEER PRESS COMPANY.
1877.

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ADDRESS.

THE UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, MINN.,
December 31, 1876.

o the President of the University:

DEAR SIR:—I have the honor to offer, and to transmit through ou to the Board of Regents of the State University, the Annual eport required by law on the progress of the Geological and Natral History Survey of the State, being the fifth since the beginning f the survey.

Very respectfully,
Your obedient servant,
N. H. WINCHELL.

STATE PUBLICATIONS RELATING TO THE GEOLOGY OF MINNESOTA.

1. *Sketch of the Lead Region, by Dr. D. F. Weinland, with a statement of the objects of a geological and natural history survey.* 34 *pp.* 1860. *Reprint from the Wisconsin Reports for* 1858. *Out of print.*
2. *Statistics and History of the Production of Iron, by A. S. Hewitt.* 47 *pp.* 1860. *Reprint of a paper read before the American Geographical and Statistical Society, January* 31, 1856. *Out of print.*
3. *Report of Anderson and Clark, Commissioners on the Geology of the State, January* 25, 1861. 8*vo.* 26 *pp. Out of print.*
4. *Report of Hanchett and Clark, November,* 1864. 8*vo.* 82 *pp. Out of print.*
5. *Report of H. H. Eames, on the Metalliferous Region bordering on Lake Superior,* 1866. 8*vo.* 23 *pages.*
6. *Report of H. H. Eames, on some of the northern and middle counties of Minnesota.* 1866. 8*vo.* 58 *pp. Out of print.*
7. *Report of Col. Charles Whittlesey on the Mineral Regions of Minnesota.* 1866. 8*vo.* 52 *pp. close type, with wood cuts.*
8. *Report of N. C. D. Taylor on the Copper District of Kettle river, incorporating Mr. James Hall's estimate of the copper prospects of that district,* 1866. 2 *pp.* 8*vo. Found only in the Executive Documents.*
9. *Report of a Geological Survey of the vicinity of Belle Plaine, Scott county, Minnesota. A. Winchell. June* 17, 1871. 8*vo.* 16 *pp.*
10. *The First Annual Report on the Geological and Natural History Survey of Minnesota, for the year* 1872. *By N. H. Winchell.* 8*vo.* 112 *pp. with a colored geological map of the State. Published in the Regents' Report for* 1872. *Out of print.*
11. *The Second Annual Report on the Geological and Natural History Survey of the State, for the year* 1873. *By N. H. Winchell and S. F. Peckham. Regents' Report*; 148 *pp.* 8*vo.*; *with Illustrations.*
12. *The Third Annual Report on the Geological and Natural History Survey of Minnesota, for the year* 1874. *By N. H. Winchell.* 41 *pp.* 8*vo. with two county maps. Published in the Regents' Report for* 1874.
13. *The Fourth Annual Report on the Geological and Natural History Survey of Minnesota, for the year* 1875. *By N. H. Winchell, assisted by M. W. Harrington*; 162 *pp.* 8*vo*; *with four county maps and a number of other illustrations. Also published in the Regents' Report for* 1875.

[NOTE.—Of the foregoing, Nos. 1, 2, 4 and 6 are wanted by the Survey.]

SUMMARY STATEMENT.

The field work of the survey was continued during a portion of the season of 1876, in the southeastern portion of the state, where the county of Houston, which borders on the Mississippi river, was examined in detail, and is herewith reported, with the necessary maps and diagrams. Later in the season the county of Hennepin was surveyed in the same manner. It was hoped that by an examination of these two counties, the latter of which embraces the interesting locality of the Falls of St. Anthony, which have receded several miles up the Mississippi from the point at which they existed in earlier geological ages, some new light would be thrown on some of the problems that invest the history of the drift, and which have presented themselves in new phases in the counties of Fillmore and Houston. In the detailed reports on Hennepin and Houston counties these problems are briefly discussed, in the light of such facts as we possess. In the further examination of the region of the Falls of St. Anthony, which embraces parts of the counties of Ramsey, Washington ad Dakota, the remainder of the great gorge excavated by the recession of the falls will come under careful inspection. Until these counties are surveyed the history of this excavation cannot be given. Some progress has, however, been made in this interesting investigation.

In the latter part of August an examination of the fossils of the Trenton was begun, including those of the Galena division. This is our chiefly fossiliforous formation. Favorable opportunities for collecting fossils from the Lower Trenton exist at Minneapolis and at St. Paul. Tolerably full collections of its fossils are found in the possession of the survey, which, added to those of the Academies of Science at St. Paul and Minneapolis, will make it possible to give, finally, a pretty good description of the Trenton fauna, as exemplified in Minnesota. In this examination, which is but just begun, there have been identified, at least provisionally—

10 species of Cephalopoda.
11 species of Gasteropoda.
11 species of Brachiopoda.
3 species of Polyp Radiates.
2 species of Crustacea.
2 species of Protozoa.

These are entirely from points in the southern part of the state. Several species have been met with that cannot be identified by any published descriptions, and a few drawings have been made.

In this connection should be mentioned the interesting fact that some indications have been discovered of an unconformability between the Devonian and Silurian which will necessitate changes in the colored county maps that have been published. This evidence is at present entirely of a palæontological character, and shows the necessity of keeping that branch of the work abreast of the field work. In the western part of Fillmore county the Niagara limestone seems to be wanting, or at least reduced to insignificant dimensions, since the Lower Devonian, or what has been regarded hitherto as rock of that age, lies but a few feet above that which contains undoubted Trenton fossils. Further examination of these outcrops is needed before the question can be fully settled.

In respect to the chemical work of the survey the report of Prof. Peckham shows what has been done. It is highly desirable that there be no further obstacles to the vigorous prosecution of the chemical investigations. The laboratory is now completed and well equipped.

In December, 1875, the Board of Regents took action ordering the commencement of thorough botanical observations, and the collection of specimens at the State University. A circular was issued asking the co-operation of the botanists of the state, and prescribing general directions for the work. A number of favorable responses have been received, and several valuable papers on the flora of different localities have been contributed. This portion of the work of the survey seems to have been eagerly taken hold of, and there is every prospect that the botany of the state will be thoroughly and at the same time economically worked up. Ultimately the aid of an expert will be needed to compare and digest the material that may be gathered. It will certainly be vastly cheaper, as well as more satisfactory to the people of the state, to carry on this great work of a state survey *as a unit*, with its different parts in harmony where each can aid the other by the various opportunities that arise, than by scattering it along so that each part is done separately. This is particularly true of the field-work. This economy and co-operation is so palpably essential that it has already bee manded by the intelligent press of the state.*

The Board of Regents have also taken action looking to the examination of the ornithology of the state, in the appointment of Dr. P. L. Hatch as ornithologist. His results, heretofore pub-

* Compare the First Annual Report on the progress of the survey, Regents' Report, pp. 41, 44, and 119: also the Fourth Annual Report, p. 11.

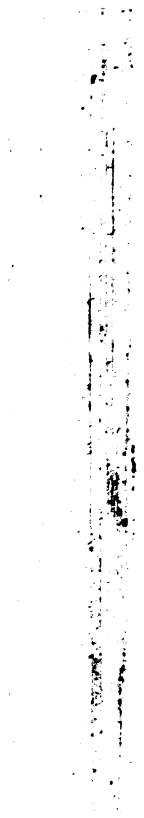
lished only in the Proceedings of the Minnesota Academy of Natural Science, will hereafter be reported to the survey, and ultimately a complete memoir on the Birds of Minnesota will be prepared. It is to be regretted that some such action had not been taken before, since many good specimens, and needed information from different parts of the state might have been secured with but little extra expense, in the prosecution of the field-work of the survey. Mr. Herrick has also collected about a hundred species of birds in the immediate vicinity of Minneapolis, which are stored in the Museum.

The entomology of the state was also begun by the Board of Regents the past year, by the appointment of an entomologist to the survey, and his first report is herewith published. He was instructed to confine himself to an investigation of insects injurious to farm products, especially to the ravages of the Rocky Mountain locust. This investigation was begun the year before by Mr. Whitman, under instructions from Gov. C. K. Davis.

Further correspondence has been had with Col. C. B. Comstock, in charge of the United States survey of the lakes, in reference to the determination of the latitude and longitude of points in Minnesota by the officers of the Lake Survey. At his request certain points were designated, the latitude and longitude of which, if ascertained, would aid the Geological and Natural History Survey of the state. In connection with the survey of Houston and Hennepin counties the usual topographical data are given.

A complete series of meteorological observations should be established at the State University. They are especially appropriate to the Agricultural College. The law ordering the survey requires the tabulation of statistics relating to the weather, and the investigation of the climate of Minnesota. An incomplete series of observations has been kept up by the writer at Minneapolis since the beginning of the survey and reported to the Chief Signal Officer of the Army at Washington. It requires, however, an outlay of about one hundred dollars for instruments to carry on the full series of observations contemplated by the Chief Signal Officer. To make a comparative study of the climate of Minnesota and of the northwest, with a view to the elimination and explanation of any peculiarities that Minnesota may possess, the observations of many observers at widely distant points must be collated. It is hoped that the survey may be able to avail itself of, if not to institute, complete observations made at the University. The Monthly Weather Reviews, which are received regularly by the University Library, will be of the greatest service in accomplishing this work.

The year has been one of special activity in the University Museum. Besides the display of the casts of fossils purchased of Prof. H. A. Ward, and the mammals obtained in the Custer expedition to the Black Hills, in 1874, the invertebrates purchased of H. T. Woodman in 1872 have been examined and labeled, and placed on exhibition. Considerable collections of plants have been made, including some fungi; about a hundred species of birds have been prepared for mounting, and several hundred specimens illustrating the paleontology of the Trenton formation have been



in respect to the Museum the
the Museum.

MINNESOTA.

Showing Locations of the Counties.

Total area 83,531 Square miles.



named, and await the construction of cases for exhibition. At the close of the Centennial exhibition at Philadelphia eight boxes of ores and minerals were obtained from the various exhibits, mostly by donation, and have already been safely deposited in the storage room in the basement of the University, where, along with more than forty other similar boxes and cases, they also await the construction of other cases for their exhibition. In addition to these a purchase was made at Hoboken, N. J., of a fine general collection of mineral species, with many duplicates, especially intended to illustrate mineralogy. These consist very largely of crystalline forms. This collection, costing $400, will comprise at least forty boxes in excess of those already mentioned. For full details in respect to the Museum the reader is referred to the report on the Museum.

MINNESOTA.

Showing Locations of the Counties.

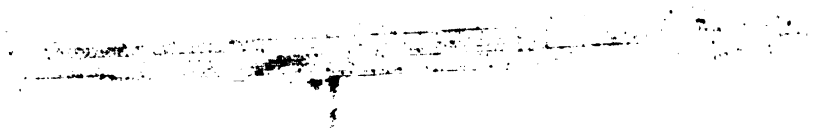
Total area 83,531 Square miles.



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II.

THE GEOLOGY OF HOUSTON COUNTY.

Situation and Area.

This county is the most southeasterly in the state, and contains sixteen government towns, forming very nearly an exact square. Its area is about 576 square miles, or 364,084.79 acres, according to the records of the State Land Office. It contains no lakes, but there are low lands both along Root river, and along the Mississippi, between the high bluffs, which are flooded most of the year. These lands when meandered by the original survey, and the actual water area of these rivers within the county, should be added to the aggregate acreage as above stated. The county seat is Caledonia. Houston, Hokah and Brownsville are the other principal towns, the last being the oldest in the county, having been settled in June, 1848.

Natural Drainage.

The general drainage is toward the Mississippi river, which lies along the east side of the county. Through the northern tier of towns Root river passes to the Mississippi. Thompson's creek joins it from the southwest at Hokah, and the south fork of Root river at Houston. It receives Money creek, Silver creek and Stover creek from the north, while Pine creek passes through the township of La Crescent and joins the Mississippi from the northwest a few miles below the village of La Crescent. Winnebago and Crooked creeks drain the southeastern portion of the county. There being no foreign drift in this county, these streams run in their ancient channels and several hundred feet below the general upland level. The loam which covers the county is generally almost impervious to water, so that these deep drainage courses do not operate to abstract the moisture from the surface soils so disastrously as they would in more sandy soils. It is only along the immediate river bluffs that any injury to the soils from this cause is noticeable. These streams furnish water power at frequent points, even more than have been improved. At some of these points the following flouring mills have been erected:

At Riceford, on Crystal creek, one custom mill, by Oatman and Co., having a power of 18 feet head. This creek issues from the rock bluffs within a few miles of Riceford, nearly all in one volume.

At Riceford Mr. V. T. Beebe also has a custom mill with 12 fe[illegible]et head of water.

There is a custom mill on Bear creek, near the state line, (Se[illegible] 34, Spring Grove,) owned by Mr. Swartzhoff.

At Freeburg, on Crooked creek, is a custom mill owned by H[illegible] and Graff, with 16 feet head of water, and a sawmill owned b[illegible] Wm. Oxford. Here are also two other mill privileges.

On Winnebago creek (Sec. 22 Winnebago) is a stone mill owne[illegible] by B. T. Barbour, and on Sec. 15 a custom mill owned by M[illegible] Millin, Johnson & Clark.

At Sheldon, on Beaver creek, is a mill of 12 feet power, owne[illegible] by John Blain, and another of the same power owned by Snyde[illegible] Brothers.

J. & C. B. Howe have a saw mill on Sec. 24, Yucatan.

Nathan Vance has a flouring mill on Sec. 12, Money creek, wit[illegible] 12 feet fall. Fox and Perkins have another on Sec. 30, with 1[illegible] feet power, from which shipments are made by railroad.

There is a mill at Houston with 7 feet fall, in the Root rive[illegible] belonging to Mr. Grorsland.

There is a shipping and custom mill SE. ¼ Sec. 23, Houston[illegible] with 20 feet power, owned by G. W. McSpadden.

At Brownsville are two mills, one by Shaller Bros. of 2 run [illegible] stone, and 12 feet power, for shipping flour, and the other by J[illegible] Hankey, of 5 feet power and one run, for custom.

At Hokah all the mills ship flour. One is owned by C. Fische[illegible] situated on Thompson creek, and has 24 feet of water fall; anothe[illegible] by White and Brothers, and a third by E. Thompson. The la[illegible] two have a fall of 9 feet in Root river. At Hokah the Railroa[illegible] Machine Shops, and the Plow Factory also run by water power.

There is also a mill on Pine creek, near the county line (Sec. [illegible] La Crescent,) with 4 run of stone, and 13 feet fall, owned by Gra[illegible] & Co., for custom and shipping; and another on the same creek[illegible], S. W. ¼ Sec 9, by J. D. Cameron, having 9 feet fall and 4 run [illegible] stone, for shipping.

The Toledo Woolen Mill, by Fletcher and Webster, S. W. ¼ Sec[illegible] 5, La Crescent, on Pine creek, has 7 feet power. This is built [illegible] stone quarried near.

Surface Features.

The topography of Houston county is very similar to that [illegible] the eastern, and particularly that of the northeastern part [illegible] Fillmore county. Taken altogether it is produced by the sam[illegible] causes. The strata cover the same geological horizons, at leas[illegible] the same as the non-drift-covered portions of Fillmore county. [illegible] varies from undulating to rough and hilly. The surface of th[illegible] rock was gorged by numerous canons, each with its tributary[illegible] gorges, prior to the spreading of the loam. These gorges ar[illegible] not so narrow as in much of the western and central parts [illegible] Fillmore county, but are of the same character as those in th[illegible] Shakopee and St. Croix areas—broader and smoother, allowing th[illegible] loam, when deposited, to enter their deepest recesses and to sprea[illegible]

itself evenly over the whole. While the loam itself becomes thicker and more clayey toward the Mississippi river, it has so effectually and so deeply covered the whole country that generally a rolling or undulating surface has resulted which is almost free from the peculiar sink-holes so common in the Trenton area, but is characterized by deep, wide valleys and long ridges. The bluffs that enclose the valleys are sometimes tillable, or at least turfed over from top to bottom. They are of all hights from the more shallow depression sufficient for ready drainage, to valley lines over five hundred feet deep. The whole of Root river valley, which is in the St. Croix sandstone, is over five hundred feet in depth, with limestone capping the bluffs. Some of its tributary valleys are equally deep and wide, but the smaller tributary valleys become shallow and more rocky as the gorges ascend in the Lower Magnesian—the whole system making a series of deep valleys along the river and of alternating vales and ridges at greater distance from the main valley. The county is nowhere destitute of excellent natural drainage. There are very few of the characteristic sink-holes of the Trenton, that formation having but a small superficies in the county, and that not within the reach of important drainage couses which were capable of producing the preglacial gorges. Within the Shakopee area have been seen three or four similar sink-holes, but they differ from the Trenton sink-holes in being more plainly a part of continuous ravines and in being broader in comparison to their depth.

If the valleys excavated by drainage were filled up, the county would be very nearly flat, the highest part being in the south-western corner, in the area of the Trenton limestone. The great diversity of surface that appears arises entirely from the effect of erosion by streams and atmospheric forces, on the rocks, which consist of alternating sandstones and limestones. This effect would be still greater, or rather would be still more apparent, were it not that the loess loam, which is very thick in this part of the state, tones down, with its overspreading canopy, the roughness which the rocky surface really possesses, leaving it actually one of an undulating or rolling character except along the immediate river bluffs, where the rocks frequently appear in craggy bluffs and cause precipitous or steep hillsides. The valleys excavated by the streams are remarkable and instructive. Not only have the larger streams cut out gorges of enormous depth in the rocky floors on which they run, but every little creek and tributary runs in a gorge which shows the same rock-sculpture. Even the freshet creeks, and the rivulets born after every summer shower, dry entirely the greater part of the year, find their way to the main valleys through rock-bound, canon-like valleys. This makes the county present the usual characters of southern latitudes where the northern drift sheet has not been spread. There is nothing more evident than that these valleys antedate to the great ice age. In other portions of the northwest where the drift does prevail, larger streams than those found in Houston county have generally worn their channels only through the drift sheet. The Mississippi river itself, above the Falls of St. Anthony, has no rocky bluffs. It very rarely even



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that of the whole Lower Magnesi
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At Sheldon the bluffs are 420 feet high.

At Houston the bluffs north of the city are 520 feet above the level of water in Root river in summer.

At Hokah Mt. Tom rises 530 feet above the flood plain of Root river.

On Sec. 11, Union, the ridge between Thompson's creek and the railroad, at the sculptured rock, rises 355 feet above the highway directly south of the ridge.

At Brownsville the hight of the bluff above the flood plain of the Mississippi is 495 feet. Mr. Fred. Gluck, of Brownsville, measured the same by triangulation in the winter season, and obtained 486 feet as the hight above the ice. Railroad surveyors are said to have obtained 483 feet as the hight of the same bluff. The most of this hight is made up of sandstone, there being but 105 feet of limestone in the upper part of the bluff, belonging to the St. Lawrence formation.

Elevations on the Caledonia and Mississippi Railroad.

This road runs from the Mississippi river westward 14¼ miles up the valley of Crooked creek. It is graded, but not yet furnished with track. These levels were furnished by Mr. Till, engineer of the road. The datum is the level of the track of the C. D. & M. R. R., just north of Crooked creek, Sec. 35, Town 102 N., Range 1 W.:

Datum	0.
Freeburg	21.92
Water at Oxford's dam, Freeburg	42.95
Crossing of Crooked creek at Sec. 36, 102 N., R. 1 W. (Powlesland's) bottom	56.32
Crossing of Crooked creek at Sec. 36, 102 N., R. 1 W. (Powlesland's) grade	65.32
Crossing of Crooked creek, SE. ¼ Sec. 26, 102 N., 2 W., below the junction of S. Fork—bottom	76.74
Crossing of Crooked creek, SE. ¼, Sec. 26, 102 N., 2 W., below the junction of S. Fork—grade	86.74
Surface of water at crossing of Crooked creek, NE. ¼ Sec. 22, Mayville	152.13
Bottom of creek at crossing of Crooked creek, NE. ¼ Sec. 22, Mayville	151.85
Bottom of creek at second crossing below John Molitor's, Sec. 16, Mayville	236.70
Grade at second crossing below John Molitor's, Sec. 16, Mayville	214.87
Bottom of creek at first crossing below John Molitor's, Sec. 16, Mayville	250.77
Grade at first crossing below John Molitor's, Sec. 16, Mayville	256.72
Dorsh's quarry, Sec. 17, Mayville, grade	333.10
Natural surface at the Methodist church, Caledonia	551.18
Summit, Natural surface, NE. ¼ Sec. 13, Caledonia	571.57

Elevations on the Houston, Hesper and Southwestern Railroad. (Proposed.)

This line runs from Houston, on the Root river, where it intersects with the Southern Minnesota Railroad, southwestwardly,

ascending the valley of Beaver creek, through Sheldon, Caledonia and Spring Grove townships. The following data were furnished by Dr. F. Worth, president of the conpany. The datum point was at Houston, on the grade of the S, M. R. R. where it crosses the line between sections 33 and 34, seven hundred and eleven feet above the ocean :

	Sections.	Above Houston.	Above the Ocean.
		Feet.	Feet.
Crossing township line between	4 and 9	6	717
Crossing section line between.....	8 and 9	7	718
Crossing section line between.....	7 and 8	7	718
Crossing section line between.....	7 and 18	9	720
Crossing section line between	18 and 19	23	734
Crossing section line between.....	19 and 30	29	740
Crossing section line between.....	30 and 31	49	760
Sheldon village plat on section 31.....		79	790
Crossing section line between.....	31 and 32	76	787
Crossing section line between	32 and 5	82	794
Crossing section line between.....	5 and 6	87	799
Crossing section line between	6 and 7	109	820
Crossing section line between.....	7 and 12	118	829
Crossing section line between.....	12 and 13	119	830
Crossing section line between.....	13 and 24	167	878
Crossing section line between.....	24 and 25	248	862
Crossing section line between.....	25 and 26	269	883
Crossing section line between.....	26 and 35	331	1,042
Crossing section line between.....	35 and 34	384	1,095
Crossing section line between	34 and 3	395	1,106
Crossing section line between	3 and 4	422	1,133
Crossing section line between.....	4 and 9	428	1,139
Crossing section line between.....	9 and 8	457	1,168
Crossing section line between.....	8 and 17	494	1,205
Crossing section line between.....	17 and 20	500	1,211
On section 17, highest point.....		524	1,235
Crossing lines between sections.....	20 and 19	456	1,167
Crossing lines between sections	19 and 30	462	1,173
Crossing lines between sections.....	30 and 25	476	1,187
Line between Houston and Fillmore Co...		562	1,273
Crossing section line between.....	25 and 26	437	1,148
Crossing section line between	26 and 35	442	1,153
State line west of center of Sec. 35, Newburg Township.....		465	1,176

Notes on the Plats of the United States Survey in Houston County, on record in the Register's Office at Caledonia. (*The county was surveyed in* 1852–3–4.)

T. 101 *N.*, 3 *W.—Fractional; East part of Jefferson.*

This is embraced wholly within the river bottoms of the Mississippi. It is timbered but low, with some marsh and standing water. Mag. Var. 8° 15' to 8° 50'. Acreage, 3,169.76.

T. 101 *N.*, 4 *W.* *West part of Jefferson and South part of Crooked Creek.*

The Mississippi bluffs run north and south across the east end of this town, which embraces some marsh and slough land in the eastern tier of sections. These bluffs, which unite with those of Winnebago creek from the west, in the southeastern corner of the town, introduce in that portion a very rough and rocky character of surface. The town is nearly covered with timber. Mag. Var. 7° 36' to 8° 45'. Acreage, 22,546.52.

T. 101 *N.*, 5 *W.* *Winnebago.*

This is crossed by Winnebago creek, which receives several tributaries from the north and from the south. There is a tract of prairie in the southwest corner of the town, and another in the northwest corner. The remainder is either timbered or shrubby with oaks and aspens. The creek valley is deep and rocky. Mag. Var. 8° to 8° 52'. Area, 23,045.05 acres.

T. 101 *N.*, 6 *W.* *Willmington.*

This town is about equally divided between prairie and timber, which are irregularly intermingled. Waterloo creek, in Secs. 29, 32 and 33, runs in a deep valley, with steep and rocky banks. Mag. Var. 5° 49' to 8° 31'. Area, 23,037.13 acres.

T. 101 *N.*, 7 *W.* *Spring Grove.*

Along the northwest edge of this town the South Fork of Root river causes a deep valley, which is rough, timbered, and rocky. The rest of the town is variously overspread with mingled prairie and timber or oak bushes, with gently undulating and sometimes rolling surface. Mag. Var. 5° 3' to 9° 5'. Area, 23,045.12 acres.

T. 102 *N.*, 4 *W.* *Crooked Creek and South part of Brownsville.*

This town is named from the creek which crosses it from west to east, south of the center. This creek, with its branches, causes a rough and rocky surface, with deep gorges over a considerable area. The town has no natural prairie. Mag. Var. 7° 35' to 8° 45'. Area, 20,403.73 acres.

T. 102 *N.*, 5 *W.* *Mayville and West part of Crooked Creek.*

In the central portion of this town are the sources of Crooked creek, which leaves the town toward the southeast, in Sec. 25. With the exception of small portions of Secs. 31 and 32, this town has no prairie, but the heaviest timber is along the creek and its tributaries. The surface is undulating to rough. Mag. Var. 6° 57' to 8° 30.' Area, 22,976.20 acres.

Beaver creek is the only stream in this town. It causes a rough and bluffy surface in Secs. 19, 18, 7, 6, 5, 8 and 17, flowing northward. A little more than one half is of prairie, the timber being along the creek and in the eastern side of the town. Mag. Var. 6° 13' to 9° 35'. Area, 23,063.95 acres.

T. 102, *R.* 7 *W.* *Black Hammer.*

The south fork of Root river crosses the western portion of this town in a northerly direction, accompanied by a heavily timbered and rocky tract affecting nearly one-half of the town. There is an irregular strip of prairie which enters the town from the southeast and runs northwest past the center. Mag. Var. 5° 24' to 8° 15'. Area, 23,042.34 acres.

T. 103 *N.*, 4 *W.* *North part of Brownsville and South part of Hokah.*

This is a border town along the Mississippi, and in the north has some bottom land east of the bluffs. In the southern portion the river approaches near the bluffs. No prairie is shown. The Wild Cat creek joins the Mississippi at Brownsville, Sec. 26, and Thompson creek flows across the northwest corner. These streams, like others in the county, run in deep, rocky valleys, and cause a great diversity of surface some distance on either side from the intermediate valley. They have a great many tributary valleys which do not contain streams, but which are equally deep and bluffy. Mag. Var. 7° 35' to 9° 1'. Area, 20,912.18 acres.

T. 103 *N.*, 5 *W.* *Union and South part of Mound Prairie.*

Root river, with its tributaries, the Crystal, Bear, and Thompson creeks, causes a rolling, and even a rough, surface over much of this town, with frequent rock exposure. There is a small area of prairie covering Sec. 4, with adjoining parts of 5, 8, 9 and 3, but the greater part of the town is represented as timbered, or overgrown with small oaks and aspens, and with hazel. Mag. Var. 6° 39' to 8° 51'. Area, 22,951.16 acres.

T. 103 *N.*, 6 *West.* *Sheldon and South part of Houston.*

The South Fork of Root river, with its tributaries from the south, Beaver, Crystal and Badger creeks, covers this town with a network of deep valleys, in many places very rough. In the eastern portion of the town the surface is more uniform and open. Mag. Var. 6° 39' to 8° 54', Area, 22,854.31 acres.

T. 103 *N.*, 7 *W.* *South part of Yucatan.*

The South Fork of Root river crosses the southeastern quarter of

this town. The whole town is rough and wooded, except a narrow prairie belt occupying the river bottoms. Mag. Var. 6° 35' to 9° 15'. Area, 23,045.67 acres.

Town 104 *N.*, 4 *W. North part of Hokah, and East part of La Crescent.*

This is a Mississippi river town, and between the line of the river bluffs and the channel of the river is a belt of bottom land, much of it marshy, from two to four miles wide. The Root river cuts a deep gorge across the southern part of the town, and Pine creek crosses the northern portion. Mag. Var. 7° 45' to 8° 58'. Area, 20,398.03 acres.

T. 104 *N.*, 5 *W. Prairie Mound and West part of La Crescent.*

This town is crossed by Root river, along the southern two tiers of sections. It has a belt of prairie within the rocky bluffs, covering Secs. 33, 34 and 35, and a marsh in Secs. 30 and 31, but the rest is more or less wooded. Pine creek also crosses the northeastern portion of the town. Mag. Var. 7° 45' to 8° 49'. Area, 23,045.07 acres.

T. 104 *N.*, 6 *W. Houston and East part of Money Creek.*

This town is broken by Root river and Money creek. It also has Silver creek in the eastern portion. There is a belt of prairie land along the south side of Root river, within the rock bluffs, and in the western portion of the town in Money creek valley, but the most of its area is wooded and broken. Area, 22,984.56 acres.

T. 104 *N.*, 7 *W. North part of Yucatan and West part of Money Creek.*

This town has prairie bottom-land along Root river, which crosses it from W. to E. in the southern half, and along Money creek in Secs. 1, 2 and 12. The rest of the town is more or less wooded, with a rolling surface. Mag. Var. 7° to 8°. 45'. Area, 23,179.03 acres.

The Soil and Timber of Houston county.

The soil of the county is formed by the loess loam. It is very fertile, and apparently very enduring. It is mainly a clayey deposit, without stones or gravel, but yet in some places becomes arenaceous, the sand grains being very fine. The loess is hardly pervious to water. In the scarcity and costliness of common wells, many farmers resort to the expedient of retaining the surface water, after rains, in open reservoirs produced by throwing a low dam across some of the shallow drainage valleys that intersect their farms, thus forming with the common loam a small pool or lake for the use of their stock. Except on the brows of the bluffs

which inclose the valleys this loam is thick enough to make a reliable subsoil as well as surface soil. In some of the valleys it is very thick, but here it is apt to be influenced by the causes that produced the river terraces and to mingle with the ordinary alluvium. On the uplands generally where it may not have been reduced by wash, its average thickness might reach 30 feet, but in some of the valleys material of the same aspect is sometimes encountered to the depth of over one hundred feet.

In the valley of Root river, and also along the Mississippi, the soil of the alluvial terraces, greatly resembling that of the loam in the uplands, is apt to be more sandy, and sometimes becomes very light and very poor. These materials are generally seen to be in obliquely stratified layers, and to embrace, in the Mississippi valley, small gravel stones of northern origin. The immediate flood plain of these rivers presents still another variety of soil. While it is generally sandy, and often very light, it is also a very rich soil, and is apt to be enduring by reason of the Nile-like overflows to which it is subjected, and the decomposition of large quantities of vegetation. This variety of soil sustains some of the heaviest forests to be found in the county.

The county is supplied with plenty of timber for fuel, and with some that is useful for lumber. The following list comprises a nearly, if not quite, complete catalogue of the trees and shrubby plants of the county:

Quercus rubra. *L.* (*?*) (Red Oak.)
Quercus macrocarpa. *Michx.* (Burr Oak.)
[These two oaks are common in the uplands. As brush and small trees they often form thickets. There are also trees of the black oak, or what are accepted as black oak by the farmers, and it may be that only the black and bur oaks exist in the county. Although considerable time has been spent in the attempt to identify this oak, mentioned in former county reports as *Q. rubra*, with doubt, it is still unsettled. There seem to be two species in some places, but in others the characters are blended in one. There is a plain popular distinction between the red and the black oak, and solitary trees of the latter are often seen of large size standing in the midst of brush, belonging apparently to a former forest growth now destroyed, while the former is very abundant as small trees or underbrush, often presenting some of the popular characteristics of the latter.]
Quercus alba, *L.* (White oak.)
Populus tremuloides, *Michx.* (Aspen.)
Populus grandidentata, *Michx.* (Great-toothed poplar.)
Populus monilifera, *Ait.* (Cottonwood.)
[Of these poplars, the first two are by far the most common, but in proportion to their numbers make fewer large trees than the last. They rarely exceed six or eight inches in diameter, while the cottonwood sometimes becomes two or three feet in diameter, as seen in the Root river valley at Houston. The cottonwood has a rough bark. The bark of the aspen may be distinguished from that of the great-toothed poplar at a distance by the fact that the former becomes white, or mottled with white, as the tree gets the size of three or four inches in diameter, while that of the latter maintains its greenish or dingy-yellow color.]
Populus balsamifera, *L.* (Balm of Gilead.) [Common in cultivation. There are some fine large trees of this kind at Mr. Powlesland's, Sec. 36, Crooked Creek.]
Populus dilatata, *Ait.* (Lombardy poplar.) [Only seen in cultivation.]
Acer rubrum, *L.* (Red maple.)
Acer saccharinum, *Wang.* (Sugar maple.)

Acer saccharinum, *Wang.* Var. nigrum, *Gray.* (Black Sugar-maple.) Sometimes known as Rock Maple.]
Ulmus Americana, *L. (Pl. Clayt.) Willd.* (American Elm.)
Ulmus fulva, *Michx.* (Slippery Elm.)
[The first named elm is very common, and acquires a very large size in he bottom lands of the Root river, but the latter is comparatively rare. As vith the oaks, the popular ideas of the elm do not agree with the scientific listinctions of Prof. Gray's Manual. Good observers and woodsmen insist nvariably that there are three elms found commonly in the central and outhern part of the state, viz., *Rock*, *Water* and *Red.* The first is easily nderstood to be the well known *American* or *White Elm*, the last the comnon *Slippery Elm*, but the second is not distinguishable by any botanical haracters. It is named from the abundant discharge of water or sap, which t furnishes on being wounded or cut, especially at certain seasons of the ear. In addition to these, sometimes a so-called *Swamp Elm* is insisted on. rof. Harrington has reported the *Corky Elm* from Olmsted county, and this ay be one of the elms popularly recognized. The demands of the geologcal work have not yet permitted the careful examination of these disinctions.]
Tilia Americana, *L.* (Basswood.)
Carya amara, *Nutt.* (Bitternut.)
Carya alba, *Nutt.* (Shag-bark hickory.)
[Of these the former furnishes the great bulk of the hoop-poles for flour arrels cut in the southern and central portions of the state, the latter being much more rare tree. It is only in Houston county that the shag-bark hickry is known to occur generally. It is exceedingly rare in Fillmore county, nd does not occur in the Big Woods.]
Juglans nigra, *L.* (Black Walnut.)
Juglans cinerea, *L.* (White Walnut or Butternut.)
[The former is comparatively rare, but the latter is one of the most comnon trees along valleys.]
Fraxinus Americana, *L.* (White Ash.)
Fraxinus sambucifolia, *Lam.* (Black Ash.)
[The former is often seen as a large tree, but the latter is rare, having beeu oted only in the timbered bottoms of the Root river at Houston.]
Prunus Americana, *Marsh.* (Wild Plum.)
Prunus Pennsylvanica, *L.* (Wild Red Cherry.)
Prunus Virginiana, *L.* (Choke Cherry.)
Prunus serotina, *Ehr.* (Black Cherry.)
Pyrus coronaria, *L.* (American Crab-apple.)
Negundo aceroides, *Mœnch.* (Box Elder.)
Crataegus coccinea, *L.* (Thorn Apple.)
Crataegus tomentosa, *L.* (Black Thorn.)
Celtis occidentalis, *L.* (Hackberry.)
Betula excelsa, *of American Authors.* (Gray Birch.)
Betula alba. var. populifolia, *Spach.* (?) (White Birch.)
[Of these two birches the latter is quite common, but the former is rare. he outer bark of the latter is snowy white, and the tree rarely becomes larger an three or four inches in diameter, and indeed is usually less than two. ; frequents rocky banks and sterile soils, being rarely seen except along a illside, where its white small trunks make it very noticeable. The former as been seen only in moist, rich lowlands, with large timber surrounding, nd is apt to grow, unless injured, to a large tree of a foot or two in diamter. It is probably the same as *B. lutea, Michx. f.* of Gray's revised manual. s twigs and bark are so aromatic as to cause it to be mistaken for the ack, or cherry-birch of the Middle and Eastern States, which has not yet en reported as occurring within the State of Minnesota.]
Pinus Strobus, *L.* (White Pine.)
[On Crooked creek; at La Crescent; on Bear creek ; on Winnebago and oney creeks.]
Ostrya Viginica, *Willd.* (Ironwood.)
Salix—Sp. (?) [Various species; one species becomes a large tree, as en in the bottoms at Houston.]
Gymnocladus Canadensis, *Lam.* (Kentucky Coffee tree.)

[The Coffee tree occasionally is seen, even 18 inches in diameter, and used for lumber. It was particularly noted about Houston.]
Larix Americana, *Michx.* (Tamarack.)
[Only known on Pine creek.]
Cornus circinata, *L'Her.* (Round-leaved Cornel.)
Cornus sericea, *L.* (Silky Cornel.)
Cornus paniculata, *L'Her.* (Panicled Cornel.)
[Along the ravines.]
Cornus alternifolia, *L.* (Alternate-leaved Cornel.]
Gaultheria procumbens, *L.* (Wintergreen.)
[Seen only at Mound Prairie.]
Alnus incana, *Willd.* (Speckled Alder.)
Diervilla trifida, *Mœnch.* (Bush Honeysuckle.)
[Along the bluffs of the Mississippi.]
Rhus typhina, *L.* (Stag-horn Sumac.)
[Rare; seen at Brownsville.]
Sambucus Canadensis, *L.* [Common Elder.]
Castanea vesca, *L.* (Chestnut.)
[Cultivated; seen on Sec 29, Union.]
Robinia Pseudacacia, *L.* (Locust.)
[Only cultivated.]
Gleditschia monosperma, *Walt.* (Water Locust.)
[Only in cultivation; seen at Hokah.]
Rosa blanda, *Ait.* (Early Wild Rose)
Rosa Carolina, *L.* (Swamp Rose.)
[This is a bushy rose, eight feet high and less.]
Rhus glabra, *L.* (Smooth Sumac.)
Rhus Toxicodendron, *L.* (Poison Ivy.)
Abies balsamea, *Marshall.* (Balsam Fir.)
[Only in cultivation.]
Rubus strigosus, *Michx.* (Red Raspberry.)
Rubus villosus, *Ait.* (High Blackberry.)
Rubus occidentalis, *L.* (Black-cap Raspberry.)
Rubus ——(?) (Low-bush Blackberry.)
[More or less trailing.]
Juniperus Sabina, *L.* Var. procumbens, *Pursh.* (Trailing Cedar.)
[Hokah and Sheldon.]
Juniperus Virginiana, *L.* (Red Cedar.)
Apocynum androsæmifolium, *L.* (Dogbane.)
Carpinus Americana, *Michx.* (Water Beech.)
Spiræa opulifolia, *L.* (Nine-bark.)
Zanthoxylum Americanum, *Mill.* (Prickly Ash.)
Amorpha canescens, *Nutt.* (Lead Plant)
Lonicera parviflora, *Lam.* (Small honeysuckle.)
Amelanchier Canadensis, *Torr. & Gray.* (Juneberry.)
Vitis cordifolia, *Michx.* (Grape.)
Ampelopsis quinquefolia, *Michx.* (Virginia Creeper.)
Celastrus scandens, *L.* (Bittersweet.)
Clematis Virginiana, *L.* (Common Virgin's Bower.)
[Common in the valley of Root river, below Hokah.]
Viburnum Lentago, *L.* (Sheepberry.)
Viburnum Opulus, *L.* (High-bush Cranberry.)
Ceanothus Americanus, *L.* (Jersey Tea.)
Aristolochia Sipho, *L'Her.*(?) (Pipe Vine.)
Ribes Cynosbati, *L.* (Gooseberry.)
Ribes floridum, *L.* (Wild Black Currant.)
Ribes rotundifolium, *Michx.* (Gooseberry.)
Corylus Americana, *Walt.* (Hazel.)
Symphoricarpus occidentalis, *R. Br.* (Wolfberry.)
Dirca palustris, *L.* (Leather-wood.)
[This was found along the bottoms of Beaver creek, in Caledonia township, in the neighborhood of the Great Spring. The wood, instead of "very brittle," as described by Gray, was pliable and spongy, resemb green cornstalk. This was in the month of July.]

Smilax rotundifolia, *L.* (Common Greenbrier.)

[This was seen growing very luxuriantly in the sandy alluvium of the Root river bottoms, below Hokah, associated with the Virgin's Bower and the Climbing Bittersweet. In the same vicinity were also the wild grape, the Virginia Creeper, and a number of herbaceous vines. The leaves on the different parts of the Greenbrier differ very noticeably. Those on the large annual shoots, which run 10 or 15 feet, are ovate and heart shaped, large, 3 inches long; those of the fruiting stems or branchlets are rarely heart-shaped, but are ovate, and less than half the size of the former. Both sorts are rough on the edges, and on the prominent ribs beneath, and are barely pointed. The Carrion Flower, *Smilax herbacea, L.*, was doubtfully identified in the ravines on the north side of the valley at Houston.]

It is noticeable that many of the valleys, particularly those running east and west, as Crooked creek valley, have the bluffs along the north side of the creek destitute, or nearly so, of timber, but are heavily timbered along the opposite bluffs, on the south side. This may be due to warm days in winter or early spring, when the sap may have started in the trees on the north bluffs, followed by severely cold weather, before the actual setting in of steady warm weather. Of course the sun's heat would be quickest felt on the bluffs facing south. This process, repeated for a good many years, would injure and at last destroy the timber on the north bluffs, if it were ever possible for trees to have come to maturity there, while timber on the south bluffs would escape these sudden changes, owing to the shaded condition of the bluffs during the warmest portion of the day, and would only experience a steady increase of warmth due to the progress of the season.

The Geological Structure.

The rocks of Houston county are embraced wholly within the Lower Silurian. They are as follows:

The *Trenton limestone*, confined to the southwestern quarter.

The *St. Peter Sandstone*, in an irregular area surrounding the area of the *Trenton* above.

The *Lower Magnesian* formation, comprising the three parts, *Shakopee limestone, Jordan sandstone* and *St. Lawrence limestone*, and underlying the greater portion of the county.

The *St. Croix sandstone*, which is found only in the bluffs of the Mississippi and Root rivers, and of their tributary valleys.

The accompanying map of the county shows the superficial areas to which each of the foregoing formations pertains. Owing to the frequent deep valleys the geographical boundaries of the formations make very crooked and tortuous lines. Although these valleys are more or less filled with the loess loam, the topography still is so marked, pertaining to and even caused by each different formation in the county, that the outlines of the geological structure are very evident to the observer. As in Fillmore county, there is more or less doubt about the position of the boundary between the St. Peter and the Lower Magnesian. The incoherency of the St. Peter causes it to crumble easily, and to leave no evidence of its final dissolution where the exact contact between the

formations cannot be examined—and the loam generally securely hides this horizon.

The Trenton Limestone.

The greater portion of this formation, which is found within the county, is of the Lower Trenton, so-called, and produces the same topographical features as in Fillmore county. The reader is referred to the report of progress for 1875, where the geology of that county is given, and the effect of the Lower Trenton on the surface features is discussed and illustrated by diagrams.

This formation is found in Spring Grove and Willmington townships. It runs also in a narrow, but interrupted belt, nearly to Caledonia, where it may be distinctly seen, in its peculiar features, and its flat-topped mounds, or tables, a mile west of that village. There is reason to suppose that it formerly extended much farther east than it does now, covering the most, perhaps the whole, of the county, and being continuous with the horizon of the same formation on the east of the Mississippi river, in Wisconsin.

The usual characters of the Lower Trenton, both lithological and palæontological, were the only ones noticed in Houston county. It has been opened for quarries only in the vicinity of Spring Grove. It generally presents a stained and long-weathered aspect, as if split and dissolved by the action of water. The layers are at first about an inch in thickness, but become thicker, by adhering to each other, on being wrought to some depth, and possess a blue color.

The St. Peter Sandstone.

This lies next below the Trenton. Its area embraces not only the slope from the high table-land of the Trenton area, but also a belt extending in width from the foot of that slope over the more level country surrounding, so that its irregular area is often a mile or two in width. As already remarked, while its upper limit has a very easily recognized location, by reason of the terrace-like topography of the Lower Trenton, its lower horizon is often very uncertain on account of the very easy and gradual destruction of its layers, and the prevalence of the loess loam.

The character of this sandstone in Houston county is about the same as described in other counties, and need not be detailed again here. It was noticed, however, that for some reason it is more frequently hardened by iron, or lime and iron in Houston county, into a firm rock, which causes it to sustain a weathered exposure without crumbling rapidly away, than in counties further north or west where the northern drift prevails. This, however, is purely an accidental and surface quality, the interior of the formation being about the same as at other places. The cement which it possesses in Houston county, in its exposed portions, in excess of the same at other points, is no doubt due to the water by which it has been submerged and stained during the deposition of the loess loam.

The thickness of the St. Peter sandstone was very satisfactorily ascertained on the S. W. ¼ Sec. 17, Wilmington. The well of Mr. O. A. Bye is situated near the Trenton bluff, and by uniting the known depth drilled in the sandstone with aneroid measurement of the bluff, the St. Peter was found to be between 75 and 80 feet thick, the Shakopee below having a thickness of 64 feet.

The Shakopee Limestone.

The continuity of this formation from the Minnesota valley to the Mississippi, and its identity with the limestone at Shakopee, where it was first recognized as a distinct member of the Lower Magnesian in Minnesota, was fully established in the survey of Houston county. It is everywhere distinct as the uppermost portion of the Lower Magnesian, and is everywhere separated from the other great calcareous member of the same formation by a sandstone as distinct and continuous, and as clearly recognizable, as the St. Peter sandstone. There can be no further question of its existence and its great extent. There seems every reason to believe also that it exists across the Mississippi, in the state of Wisconsin, but at this time there is no distinct published notice of its occurrence there. The Lower Magnesian in Wisconsin has been divided by Prof. R. Irving, of the Geological Survey of Wisconsin, into three parts, as exemplified near Madison, (*American Journal of Science and Arts, June*, 1875,) but there is much reason to believe that his proposed subdivisons do not include the Shakopee limestone at all, and that the distinctions in the Lower Magnesian which he mentions are wholly confined to the St. Lawrence limestone of Minnesota. This subject was discussed by the writer in the *Bulletin of the Minnesota Academy of Natural Sciences, for* 1875, when this hypothesis was first published. It is rendered still more plausible, in the absence of further facts in Wisconsin, from the fact that even in Houston county the St. Lawrence exhibits variations of composition and lithology which are comparable to those Prof. Irving describes.

The characters of the Shakopee in Houston county are not noticeably different from those mentioned in the reports of progress for 1873 and 1875. Its bedding is much less regular than that of the St. Lawrence. It is apt, indeed, to be disturbed by cherty, or concretionary masses, which on the weathering away of the bluffs become detached and fall into the bottom of the valley, where they lie long after the non-silicious portions of the rock have dissolved and disappeared. Such cherty lumps are often a foot, or even two or three feet in diameter. They are roughened by cavities opening on the surface, by dissolution of the most calcareous parts, and by the natural openings and pores they acquired in the act of formation. They are the only portions of the formation in which fossils have been found in Houston county. These masses sometimes show surfaces of drusy quartz crystals, also amethyst crystals, and great quantities of pyrites, oxydized and hydrated so as to produce a limonite, the form of the crystal alone remaining to indicate the original mineral. A careful study of these fossils has

not yet been made, but there is some evidence, from the handling to which some of them have been subjected in the examination of the Trenton fossils now going on, that the Shakopee limestone is the equivalent of the Chazy of New York, a formation which has not been recognized in the state, though the St. Peter has been regarded by Prof. Hall as its equivalent.

This formation does not appear in the bluffs of the Mississippi river, in Houston county, nor in those of Root river generally: but its line of strike is some miles back in the country away from the immediate bluffs. This is due to the crumbling nature of the Jordan sandstone which underlies it, and which operates, in that respect, to tear down the Shakopee in the same manner, and for the same causes, as the St. Peter on the Trenton. To this fact, and to its general resemblance to the St. Lawrence limestone, may be attributed the non-discovery of this limestone by the United States geologists who have reported on the geology of the state, or by others, whose examinations were largely confined to the main water courses, before the general settlement of the state and the construction of good roads. Its area is embraced, on the colored map of the county, in that assigned to the Lower Magnesian.

This limestone may be seen frequently in the central portion of the county, in the upper reaches of the ravines which radiate in all directions from the vicinity of Caledonia. It is seldom quarried, or used for any purpose, for the St. Lawrence limestone is generally accessible in the immediate neighborhood, and that is much more desirable for building-stone, or for lime-making. In descending the ravine toward the quarries east of Caledonia the Shakopee is the first limestone seen exposed. The quarries are much lower—in the St. Lawrence. It may be seen also in the upper tributary valleys that feed Badger, Beaver, Crystal and Thompson creeks. It causes the first rugged or rocky portion of those valleys. It is exposed in the tops of the bluffs at the great spring, Sec. 17, Caledonia, three miles south of Sheldon. Its thickness at Mr. O. A. Bye's, Sec. 17, Willmington, when drilled through, was found to be 64 feet, which is probably about its average thickness throughout the county.

The Jordan Sandstone.

The lithological features of this sandstone are nearly the same as those of the St Peter, but it has only about one-half the thickness of the St. Peter. Its area of outcrop is quite small, and its exposures are few. As it lies between two hard limestones, which are apt to form perpendicular, walled bluffs, its line of outcrop is known by a belt of non-exposure of rock separating the Shakopee from the St. Lawrence, which is less steep in the ascent, and perhaps turfed over. It often becomes rusty and firm from a cement of iron, when it endures longer exposure, and is seen as detached blocks in the valleys. Some blocks of this kind are visible by the roadside in the ravine that descends to the quarries of Aikin and Molitor, a mile east of Caledonia.

The St. Lawrence Limestone.

This is the most important formation in the county. It not ıly occupies a greater superficial area of outcrop than any other, ıt it takes the most prominent part in causing the varied topog- phy of the county. It surmounts the St. Croix sandstone, an sily eroded rock, into which the valleys are deeply and rapidly t, and maintains a bold and sharp outline along their tops. It the immediate cause of a great many hills and ridges. It con- ɔnts the observer in every nook and on every promontory, along e whole course of the Root river, and down the Mississippi bluffs far as the state line, and it is especially conspicuous in the little lleys that ascend from the streams, and that often are more rocky an the larger valleys.

The thickness of the St. Lawrence in Houston county is about 0 feet, though other geologists have reported it as 250 feet thick La Crosse. It is a dolomite, or magnesian limestone. Its lay- s, while generally regular and useful as a building-stone, are so sometimes very much brecciated, rendering it at once more m, but also more refractory. It furnishes more stone for build- g than all the other formations of the county combined. It is of light, lively color, and endures the weather perfectly, showing ɔt the least change in the oldest buildings in which it has been ıed.

The St. Croix Sandstone.

This name was applied, in the first annual report, provisionally) the light-colored and often friable sandstones which occur along ıe Mississippi river in Minnesota, and which have by some been ;garded as the stratigraphical equivalent of the Potsdam sand- ;one of New York. This was done because, in the existence of ıpther formation, of different lithology, affirmed also to be the ıuivalent of the New York Potsdam, it was necessary to have ıme designation for each of them. It seemed from considerations ıere given, that the lower of these two sandstones was the prob- ɔle equivalent of that formation in New York, and in subsequent ;ports, while no facts have been gathered that confirmed that ;ew, the survey not having been carried on where these rocks are ɛposed, the provisional name has been continued. It is only in ıe county of Houston that any opportunity has been afforded for ı examination of this formation, since the season of 1872.

It is not intended here to enter upon an examination of the ridences of the parallelism of this sandstone with any eastern ırmation, nor to cite or compare authorities one way or the other. onsiderable has been written on the sandstones of the Lake uperior region as developed in Michigan, Wisconsin and Canada, ;nding to show the existence of two distinct sandstone formations. 'rof. Irving (American Journal, 3rd Series, Vol. VIII, p. 46.) eports *three* different sandstones existing in the northwest in- olved in this disputed horizon, as exemplified in his study of ıorthwestern Wisconsin, viz.: (1) Copper-bearing, highly tilted

sandstones, conglomerates and shales, associated with trap. (2) Horizontal, aluminous, red sandstones, lighter than those associated with the trap, which "*appear to dip* underneath the light colored Lower Silurian sandstones of the Mississippi Valley," and (3) the light-colored sandstones of the Mississippi valley. In this he agrees with Dr. C. Rominger (Vol. I, p. 95, Palaeozoic Rocks, Geological Survey of Michigan,) who makes them—(1) Copper-bearing rocks, (2) Lower Division of the Lake Superior sandstone, and (3) the Upper Division of the Lake Superior sandstone. Brooks and Pumpelly, however, do not make mention of but two series of sandstones in the Lake Superior region, viz.: (1) The copper-bearing series, and (2) the Silurian sandstones. (Michigan Geological Survey. Vol. 1. Part I, pp. 75 and 185; and Part II. p. 1.) Foster and Whitney in 1851 referred all the sandstones in question to the Potsdam of N. Y., regarding them as deposited over an uneven surface, producing local cross-stratification and unconformability. (Report on the Geology of the Lake Superior Land District. Part II, p. 120.) In this they were seconded by Prof. James Hall, and followed by Prof. J. D. Dana in his Geological Manual, First Edition. More lately, in 1862, Prof. Hall parallelized the uppermost of these sandstones with the New York Potsdam, (16th Regents' Report, p. 119,) with the cautionary remark that "it may not yet be regarded as proved that the sandstone from which I have described these fossils is in all respects the equivalent of the Potsdam sandstone of New York, Vermont and Canada. It may represent more, or it may represent less than that formation. The *lower* accessible beds of the Mississippi valley may represent the Potsdam of one hundred and fifty or two hundred feet in thickness in the typical localities in New York, while the middle and upper beds of the west may be of epochs not represented in that part of the series studied in New York." As long as the Potsdam sandstone at the typical localities in New York was accepted as the base of the fossiliferous primordial strata, while at the west there are two recognized sedimentary sandstones, though not yet proved fossiliferous, lying below the sandstones of the Mississippi valley, it seems quite presumptious to affirm the horizontality of the light-colored sandstones with the New York Potsdam, especially when, as admitted by Prof. Hall, "there are no species of fossils in the western sandstones which are positively identical with those of New York." It would be more in keeping with recognizing stratigraphical laws, to allow that formation which in New York begins with the top of the "azoic" to begin there also in Minnesota.

In this state of the question concerning these sandstones it seems justifiable to retain for the present the term St. Croix, inasmuch as there can then be no misunderstanding of the horizon under consideration. It is perfectly legitimate, in the further investigation of this question, for the geologists of states further east to inquire which of the sandstones lying below these beds may be the equivalent of the New York Potsdam, for it seems as if on ascertained stratigraphical evidence, as well as on lithological and palæontological facts that are undisputed, these beds occupy

a much higher horizon. They seem rather to be embraced in the great calciferous or Canadian epoch.

Although these sandstone beds occupy the river bluffs along the Mississippi and the Root river throughout the county, they afford but very few opportunities for satisfactory examination. They are on the lowest part of the bluffs and are generally hid by a sloping talus that is usually turfed over. The only point at which a useful section of their composition could be had was at Hokah. The general section at this place, as nearly as it could be made out, is as follows, in descending order:

General Section at Hokah.

	Feet.
St. Lawrence limestone, of the Lower Magnesian, about	200
Slope, unseen	80
Sandstone, line of constant exposure	80
Slope, rock unseen	30
Whitman's quarry, made up as follows:	
1. Broken, shaly, and sandy, crumbling and fragmentary	10
2. Shale bed, greenish, with remains of trilobites	1
3. Tough, persistent layers, like an indurated, arenaceous shale, with green sand, in thin layers	12
4. Crumbling sand, in oblique stratification	3
Rock very similar to No. 3 extends downward, covering the horizon of an old quarry east of Hokah, now abandoned as worthless, embracing a thickness, that is generally a turfed slope, of about	150
Rusty, coarsely arenaceous sandrock with Lingulepis (Lingula)	10
Crumbling, white sandrock, massive	25
Variegated, arenaceous quartzyte, purple and white, hard and persistent, level with the top of the dam	2
Massive, white sandrock	20
Total rock, about	523

The hight of Mt. Tom at Hokah, by aneroid, above the flood plain, was found to be 530 feet.

At an old quarry east of Hokah, and across Thompson's creek, now abandoned because the rock is worthless for all purposes, the general aspect of the layers is much like that at Whitman's quarry, but the sand is less firmly cemented, making a stone not so good. It is a shaly and arenaceous standstone, of coarse and fine grain, marked with fucoids and abundant greensand, and is below the stratigraphical level of Whitman's. In the same bluff, about twenty-five feet higher, is a blind shoulder or terrace which is more likely to contain the layers of Whitman's quarry. This stone as taken from Whitman's quarry, although very shaly, becomes firm and enduring on exposure.

At Houston the bluffs north of the village are 520 feet in hight, and of this the lower 420 feet at least belongs to the St. Croix sandstone. They probably contain the St. Croix 20 feet further up, shown by the toppling over of huge blocks of St. Lawrence limestone, from the crumbling out of friable sandrock along the salient angles of the bluffs. The interval of the sandstone layers is mainly turfed over so as to render an inspection of their contents impossible, except at points near the top and near the bottom. There is a line of nearly constant exposure about 40 feet

below the top of the St. Croix, occupying an interval of 30 or 40 feet, which is particularly noticeable along the north side of the river, and was mentioned in the report on Fillmore county. There is another exposure of these beds near the level of the river at the dam at Houston. The former consists of a hard, firm sandrock, and the latter is soft and crumbling, with cross stratification. Above the line of constant exposure, about 25 feet, is a blind terrace which occasionally reveals the rock which causes it. It is a sandstone, and is included in the foregoing thickness of 120 feet.

At one mile north of Sheldon there is an apparent dip in the outcropping upper edge of the St. Croix, as it strikes across the bluffs. Its direction is perhaps a little west of south, and amounts to two or three degrees. It is entirely local, and the corresponding upward dip in the opposite direction is invisible. The bluffs south and north have their usual hight.* No such dip was noticed in any other part of Houston county, but it is very likely this is on the strike of the noticeable dip in these formations which has been mentioned by Dr. Owen and by the geologists of Iowa occurring in the bluffs of the Mississippi river at McGregor and Lansing, in the State of Iowa.

In Caledonia township, Sec. 2, the following section was taken

Section covering the junction between the St. Croix and the St. Lawrence.

	Feet
Slope, covered with large blocks of limestone	200–300
Even layers of limestone quarried	12
Hid. Mainly limestone, like the next	40
Limestone, broken and curling bedding. Cherty, arenaceous or massive with some green sand	25
Lime and sand, lumpy with irregular concretions, mainly massive	15–20
Soft sand, with cemented or quartzitic lenticular lumps	10
Soft, massive sand. (Causes the blind terrace at Houston)	25

The line of constant exposure mentioned as occurring at Houston, near the top of the St. Croix sandstone, lies below this section. This line is more evident in the north than on the south bluffs—due, probably, to the erosive action of the prevailing winds, which are from the southwest, and to the greater scarcity of timber on the north bluffs, as already noted under the head of *Soil and Timber*.

The fossils that have been gathered from this formation consist very largely of trilobite remains. They will be examined as opportunity may be afforded in the future progress of the survey.

On Sec. 11, Union township, the sandstone which has been mentioned as having a nearly constant line of exposure, is sculptured, along the north bluffs, into isolated columns and tables with some rounded buttresses which present a very conspicuous and highly interesting instance of atmospheric erosion. There can be no doubt that the bluffs themselves are the result of the erosion of the valley by water by a process that began thousands

* Compare *Geology of Iowa, Hall & Whitney, 1858, Part II, p. 61.*

of years before the glacial epoch, but the present condition of most of the curious forms, like that of the "sculptured bluffs," is certainly due to the effect of wind in conjunction with moisture and frost. There are also cavities and sheltered nooks, and deep, crooked passages and sharp niches in which the wind could barely enter, and from which there could not have been any wind exit sufficient to have maintained a current capable of producing the most of this sculpture, which, moreover, are lichen-covered, and bear an aspect of age and roughness that forbids their reference to any present atmospheric forces. These can be explained only by the solvent action of water in agitation, and are comparable to the purgatories that are often seen about the rocky shores of lakes or of the ocean. But when the rock shows a recent, fresh erosion, and is soft and crumbling, the present forms are due to more recent causes, and can only be assigned to wind and frost.

The Drift.

The true northern drift is not spread over this county. It contains no drift clay, nor boulders of foreign origin. There is a thin deposit of foreign gravel at Riceford, in the extreme southwestern part of the county, and there is a terrace along the Mississippi river that is made up of gravel and sand of northern origin, but this county wholly escaped the operation of those forces which spread the well-known drift clay and boulders over the most of the state. Whether any former glacial era caused it to be covered with the ice of the northern glaciers cannot be determined, since the materials left by that era, if any there were, may have been decomposed, and may have entered into the stratified clays and the soils of the Mississippi valley further south under the combined influence of time, and the intense activity of the destructive forces of the latest glacial era.

There is to be seen occasionally a local drift, or debris, derived from the rock of the country round about, and this sometimes has a deceitful resemblance to true northern drift, yet it can always be distinguished from it on examination. On the northwest quarter of section 25, Caledonia, along the road, near the brow of the Shakopee limestone, there is a bank of such loose materials. There is a cut of about three feet, which consists mainly of rusty loam, rather sandy, embracing large masses of black quartzite, which also vary to a lighter color but show very little, if any, lime. Other lumps consist of pyrite crystals, now converted to limonite, and of rusty, hardened sandstone, perhaps from the St. Peter. These last, indeed, comprise perhaps a majority of the stony masses. There are also large quantities of ordinary chert, and an occasional piece of water-worn limestone. The bank shows no stratification, but consists of these materials simply mingled with the loam. The whole appears red and rusty, but discloses not a single piece but can be referred to the Lower Magnesian formation.

As to the cause of this exemption of a part of southwestern Minnesota, and portions of Wisconsin, Iowa and Illinois adjacent, from the forces of the northern drift epoch, there has been but one

In the light of the more recent investigations of geologists it is safe to take for granted the following conclusions respecting the drift, so far as they bear on this question.

1st. That the earth suffers such changes of climate that, after the lapse of long periods, the temperate latitudes become frigid and are covered with continental ice-fields or glaciers, which have a slow movement southward.

2d. That between these periods conditions of more genial climate prevail, when vegetation and animal life return slowly to inhabit the countries from which they had been driven by the rigors of the previous cold.

3d. That the severity of the cold during the successive glacial epochs is not always the same; but that the ice-fields are more extensive during some than during others.

These continental ice-fields, while conforming in general to the laws and conditions of a solid, yet exhibited, as glaciers do now, many of the characteristics of a plastic body, warped and moved by the force of gravity, and hence exemplified many of the principles of running water. The tendency for them was to seek the low lands and to avoid the natural obstructions presented by mountains or by hills.

In examining the topography and the geological structure of the country lying to the north of this so-called driftless tract, it is evi-

* Those interested in this subject will find it exhaustively treated in James Geikie's *Great Ice Age, and its relation to the antiquity of Man.* Second Edition, 1877.

nt that the great valley of the Lake Superior region, once occupied
r glacial ice, would overflow, both first and last, along the lines
the lowest outlet, and that perhaps the higher and less passable
arts along its southern barrier-shore would never be entirely sur-
ounted. The continental glacier, in this region, would flow
ward the southwest or south, guided by the main topographical
atures. In north-central Wisconsin is an isolated area of gran-
ic and metamorphic rock, which not only extends to the shore of
ake Superior, but wedges out northeastwardly in the form of a
ng, high and persistent point or spur, in the southern part of
ake Superior, known as Kewenaw Point, in the State of Michi-
an. It is plain to see that this point would act on a crowding
ut somewhat flexible mass of ice as an entering wedge to split it
ito two main masses, and that the widening of the wedge, in the
ranitic region of northern Wisconsin, would perpetuate the divis-
n so as to cause, if other topography were favorable, a constant
ow along the northwest side, and another in a more southerly
irection, that would spread over northern Michigan and find its
asiest exit through the valleys of lakes Michigan and Huron.
ccording to Prof. R. Irving, and Messrs. Foster & Whitney,* the
estern end of Lake Superior lies in an Archaean synclinal trough
unning southwesterly. This again would divert the flowing ice
ver the northeastern portions of Minnesota to the expense of
orthern Wisconsin. Glacial scratches on the rocks at Duluth,
t the western extremity of the lake, have a west-southwesterly
irection.

Now it is a striking coincidence that this driftless tract lies
early south and in the lee of this wedge-like area of metamorphic
ock, and would be protected from the ice-flow by it. It is hence
easonable to infer that the absence of the drift in this region is
ue to the existence of this protecting barrier lying to the north
f it in Wisconsin, while further to the south the two main
ranches of the ice-flow again united and spread, before their final
etirement, a continuous sheet of drift over central Illinois, and
outhern Iowa.

It is very evident, from the fact that the remains of an older drift
heet are found under the loam in some of the western parts of this
ract, (see report on Fillmore county,) while the latest drift sheet
oes not spread so far nor so wide, that the last period of cold was
ar less intense than some former one had been. This last drift
heet is spread over the ancient soil, containing vegetation in a
early continuous layer, the remains of a forest which flourished
etween the two glacial periods, along the margin of the last ice-
eld. This belt, characterized by buried soils and wood, crosses
illmore and Olmsted counties, and it is probably true that wher-
ver such remains are found, in a flat country like southern Min-
esota, lying under glacial drift, they mark the point where glacier
ce ceased to act powerfully enough to disrupt the old soils. Such
ncient soils may have existed on the top of older glacial drift, or
n any other surface. It is probable that it was during the pre-

*American Journal of Science, 3d Series, Vol. VIII, p. 54. Report on the Geology of the Lake Superior Land District.

valence of the last glacial period, or just as the ice began to recede so as to produce copious waters, that the loess loam of the Mississippi valley was deposited over this region, and that at the same time the waters of the Minnesota were augmented by the drainage of the entire Winnepeg and Red river valleys through its channel, some of them at first reaching the Mississippi through the Cannon and the Vermillion river valleys. At first these waters spread irregularly and widely, fluctuating with the seasons, so as to leave no recognizable beach lines; but at length when the most of the state had been left by the retreating glacier, they became more uniform in their volume and were confined to the actual river gorge. They seem to have maintained, for a long period, a pretty uniform stage at this point, for when, on the drainage of the Winnepeg basin toward the north, consequent on the final retreat of the ice beyond the mouth of the Nelson river, in British America, the Minnesota was reduced to about its present dimensions, a high terrace was left along the Mississippi, through all this driftless region and also further south. The high water in the Mississippi ascended the gorges of the tributary streams, retarding their flow and causing similar terraces along their lower reaches.

[NOTE.—In the report for 1875 it was stated (page 66) that no drift-clay like that which covers the western part of Fillmore county had been seen overlain by the loess-loam, except that which pertains to the general drift sheet of the northwest, where the loam overlaps the later drift. In passing through Fillmore county in 1876, the remains of this ancient drift sheet were seen at numerous places between Sec. 4, Canton, and Lenora. At one point it is a light-colored, or ashen, gravelly clay which above is very iron or rusty. Over the surface are numerous fragments of chert with some small boulders of granite, and greenstone, and jasper and quartzite pebbles. This is the first satisfactory identification of the *old* gravelly clay within the loam-covered area, or driftless tract. It is covered with several feet of loam. It is seen similarly NE. ¼, Sec. 12, Canton.]

Alluvial Terraces.

There is a marked alluvial terrace that accompanies the Mississippi and Root rivers, and ascends their lower tributaries, but it does not seem to be true that all the streams are terraced before reaching the level of this terrace. This indicates that the high water which produced that terrace was due to backing up from the Mississippi, and that possibly the country itself in general was not more wet than it is at present; in other words, that the amount of surface drainage that passed down the valleys was no greater than now. Root river was simply wider and deeper, with a sluggish current, due to the greater volume of the Mississippi. The highest point at which the terraced condition of Root river has been observed is Preston, in Fillmore county, but it must certainly extend several miles further up that valley. By aneroid measurements, united with levels of the S. M. R. R., the hight of this terrace at Preston is found to be about 300 feet above the Grand Crossing of the S. M. R. R. near the mouth of Root river, while the same terrace at Hokah, likewise near the mouth of Root river, is only about 100 feet above the flood plain. It is also probable

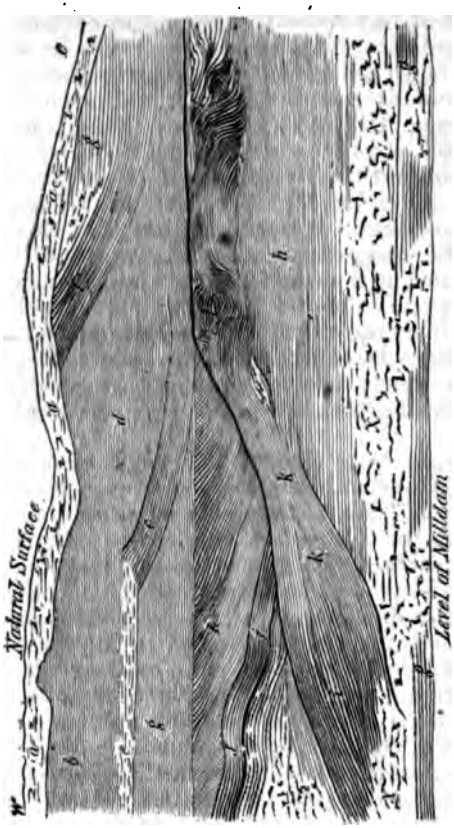
iat the loam terrace, as seen at La Crescent, is the same contin-
ed to and coalescent with the Mississippi terrace ; and there it is
) feet above the Mississippi flood plain. This would necessitate a
.ll of about 200 feet in the Root river at its highest stage, in a dis-
ance of 50 miles in a right line. If this fall can be explained con-
stently with the assumed back-water condition of the Root river,
; that time, it will further confirm the hypothesis that the Mis-
ssippi then drained the Red River and Winnipeg regions, receiv-
ig their waters from the Minnesota. It seems further that this
xplanation is necessary to the maintenance of that hypothesis ;
r if Root river was maintained at that high level by the demands
' its own drainage area, then much more the Mississippi could
so have been kept there without the aid of the Winnipeg waters.
oot river valley, between the rock-bluffs, has an average width,
irough Houston county, of about two miles, and that would
ave been the width of the stream, with a depth of over one hun-
ed feet.

There is, besides this high, loam-terrace, a second terrace
vel, visible specially at La Crescent, on the Mississippi, which
iere rises 50 feet above the flood plain of the river and spreads out
i a pleasant plateau on which the village has been located. This
rrace is made of gravel and pebbles of northern origin, and was
entified only along the Mississippi. The largest stones it con-
ins are about 3 in. in longest diameter. It is passed through
i wells, and seems to be entirely pervious to water, as all wells
a it get water at about the level of the flood plain of the river.
his material is used for grading, and road-bed, on the C. D. & M.
. R., and elsewhere. It consists entirely of rounded waterworn
iaterials, the main part being the usual parti-colored quartzite
ebbles, granitic, hornblendic, amyglaloidal, and lamellar, as well
s uniform and massive. A great many of them have a red color,
r some shade varying from red. The coarsest pieces are rare,
)und only in the upper portions of the *debris* of alluvial fans.

The following more special observations were made on these ter-
ices in Houston county. At Sheldon, six miles from Root river,
i the valley of Beaver creek, the terrace on which the Newberry
ouse stands is 30 feet above the water of the creek below the
am. The materials of the terrace at this place are sandy loam
)rizontally stratified, with more clay near the top, and less evi-
:nt stratification.

At Houston the only observable terrace, measured about a mile
est of the city, is 65 feet above the flood plain. The track of the
. R., is about one foot above the flood plain of the river, which
18 feet higher than the water below the mill-dam.

At Money creek the terrace rises 30 feet above the flood plain
hich is 20 feet above low water below the mill-dam. The con-
:nts of the terrace are stratified. On Sec. 30 in this town the
ontents of the Root river terrace, and their arrangement, are
iown by the following sketch which was taken on the spot :



The full hight of the bank is about 20 feet where the section is taken. At a point further to the right than is shown in the sketch a couple of bones were found, but in the confused and broken uppermost layer. They were where that layer comes down to the river, and about 3 feet below the surface, or 5 feet above the water of the dam, the surface of the bank sloping about 45 degrees.

At Hokah the village is on a terrace 65 feet above the flood-plain of Root river, and there is a distribution of loam about the bluffs at a higher level, (as well as at many other points along Root river valley) reaching to a hundred feet, or a little more, above the flood-plain. This loam appears in indistinct benches or terrace-levels, or patches of terrace, rising often with a slope, far up the rock-bluffs. It very rarely appears level, as a well-marked terrace. It suggests rather a worn-out old terrace-level, the upper surface of which has suffered erosion by being gullied out and smoothed off toward the river. It is generally cultivated for farms, and has good wheat-fields, consisting of the same materials as the lower terrace. Its actual hight is difficult to ascertain.

SW. ¼ Sec. 22, La Crescent. By the roadside appears a terrace

rising about 50 feet, which at the top consists of the fine loam of which the foregoing terrace is composed, showing at least eight feet of such material, while its lower 20 feet are of drift-gravel, which is coarse and obliquely stratified, the coarsest pebbles being one or two inches in diameter. This occurs on the rounded point of the rock-bluff which faces both valleys.

The village of La Crescent stands on a beautiful terrace of drift-gravel, generously laid out, with wide streets and alleys, 50 feet above the flood-plain of the Mississippi. This terrace slopes gradually toward the high rock-bluffs. It is surmounted, along the bluffs, by another terrace, rising 40 feet higher, which consists of loam.

This drift-gravel must be attributed to the agency of the river. It has every feature of a water-worn alluvial deposit. It is not found in Houston county in any of the valleys of other streams, back from the Mississippi. It ante-dates the loess loam, as that is terraced above it, and probably bears the same relation to an earlier glacial epoch as the terraced loam does to the last.

At Brownsville the loam-terrace is 80 feet above the flood-plain of the Mississippi.

At Yucatan the terrace flat is 40 feet above the present flood-plain of the South Fork of Root river. The flood-plain is 6 feet above low water.

At Freeburg the terrace is 20 feet the flood-plain of Crooked creek, which is 5 feet above the water of the creek.

Wells in Houston County.

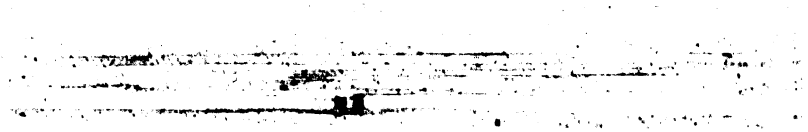
A few wells situated in the valley of Root river have disclosed vegetable remains at about the level of the flood-plain, and probably the terraces generally cover a layer of vegetable remains that was caused by the decay and burial of pre-glacial plants. This has only been detected, so far as known, at Hokah, and at La Crescent. At the former place the well of Isaac West was filled again because the "muck-bed" rendered the water unfit for use. The same is true of William Wykoff's and W. F. Weber's, and a number of others. Probably the characters of Mr. Pidge's, as given below, are those common to most of them.

B. F. Pidge's Well at Hokah.

It is situated on the lower terrace.

	Feet.
Loam and sand	50 or 55
Vegetation, leaves, stick, muck, &c,	4
Sand, with some course pubbles, "literally filled with snail shells"	4
White sand, yielding water	5

The water of this well tastes rather peculiar, and at first it was not fit for use. Sometimes still it comes up black, like dye, but by use it becomes clearer, and is used for all domestic purposes, without injurious effects. Sugar of lead causes it to become milky white. Acetate of potassa produces no change; sulphate of zinc



Wells in Houston County.

Owner's Name and Location	Loam, Feet.	In the Rock, Ft.	Total Feet.	Kind of Water.	Remarks.
Timon Gilbertson, Spring Grove	7	40	47	Good.	
Mons Fladager, Spring Grove	8	122	130	Good.	Drilled.
Ingval Miller, Spring Grove	10	30	40	Good.	On lower ground.
Nels Hendrickson, Spring Grove	8	77	85	Good.	
Ole Thompson, section 7, Willmington	8	65	73	Good.	
J. Dailey, N. E. ¼, section 34, Caledonia	28	72	100		No water.
Public Well, Caledonia	25	245	270	Good.	
W. N. West, Caladonia	20	50	70	Good.	
A. Calmus, Caledonia	20	23	43	Good.	
M. Creagan, Caledonia	20	23	43	Good.	
O. A. Bye, S. W. ¼, section 17, Willmington	18	77	95	Good.	Two feet sandrock ; 64 feet limerock ; 11 feet sandrock.
W. H. Harris, Caledonia	18	33	51	Good.	
M. Newberry, Sheldon	38		38	Good.	The rock has never been struck at Sheldon.
J. B. Williams, Sheldon	36		36	Good.	
Cottrell Hotel, Houston	16		16	Good.	Eight feet to water. All alluvium.
W. R. Anderson, La Crescent	57		57	Good.	At 54 feet struck leaves, &c.
D. Gurley, La Crescent	49		49	Good.	Gravel and sand.
Sawyer House, La Crescent	45		45	Good.	Gravel and sand.
James Day, La Crescent	50		50	Good.	Gravel and sand.
James Brown, La Crescent	45		45	Bad.	Sticks and leaves ; refilled.
J. Knapp, La Crescent	63		63	Good.	Gravel and sand.
Wm. Miller, La Crescent	30		30	Good.	On lower ground.
Chas. Oldenbaugh, La Crescent	20		20	Good.	On low ground, near the rock bluff.
Thomas Minshall, La Crescent	37	11	48	Good.	On low bench.
Jos. Garner, La Crescent	30		30	Good.	On low bench.
Nicholas Prive, section 31, Caledonia	12	2	14	Good.	Four feet of water.
B. Smitz, section 32, Caledonia	12	10	22	Good.	Ten feet in sandrock.
N. Charles, section 32, Caledonia	12		12	Good.	
G. Anderson, section 4, Willmington			40	Good.	Drilled.
John Prive, section 33, Caledonia	12	90	102	Good.	
M. Blasen, section 33, Caledonia	12	36	48	Good.	
Ole Hanson, section 4, Willmington	15	55	70	Good.	Drilled.
Peter Carrier, section 32, Yucatan	55		55	Good.	In the valley : no rock struck.

Throughout the county are numerous springs, some of which are very large, and gush out along the valleys. They seem to be the outlets of subterranean streams. Those above Riceford furnish the water for the flouring mills at that place. There is also a large one on Sec. 17, Caledonia, three miles south of Sheldon. They seem to frequent the horizon of about 80 feet below the top of the St. Lawrence limestone, and indicate a shaly, or otherwise impervious, layer there in that formation.

Material Resources.

The rocks of the county do not contain any valuable minerals. They are everywhere abundantly exposed, and are quarried at many places for ordinary building-stone and for quicklime.

Building Stone.

At Spring Grove the Lutheran society is building a large church, of brick, the basement being from the Lower Trenton, in layers of four to six inches, taken from quarries near the village. The heavy trimmings are from the St. Lawrence limestone. The quarries are owned by George Timansen and Ole Tostenson.

The Toledo Woolen Mill, of Fletcher & Williams, Sec. 5, La Crescent, is built of the St. Lawrence, quarried near.

At Caledonia the St. Lawrence is extensively used for building, quarried about a mile east of the village. The German Catholic church is the principal building made of it, being also the largest building in the place. The county jail is a fine building of the same, the courses being about ten inches thick, rubble dressed, with trimmings of the same. The business blocks of Nicholas Koob, J. J. Belden, John Krantz, Joseph Vossen, Jacob Bouquet and Nix Erstine are also constructed of the same stone. The quarries are owned by John Molitor, John Dorsh, Anton Molitor, Widow Cunningham and John Aiken.

On Sec. 24, Spring Grove, Mr. K. Gilbertson has a two-story stone residence on his farm, quarried from the Trenton.

At Money Creek, Harvey Chapel has a quarry that furnishes good stone for building, though much of that which is used is taken from the surface near the tops of the bluffs, having been loosened and broken up by the weather.

On the NE. ¼ Sec. 11, Caledonia, is Mrs. M. Brown's stone house, built of the Lower Magnesian.

Mr. J. Kline has a fine farm-house of stone taken from the St. Lawrence, on Sec. 19, Union. Near Mr. Kline's quarry is another owned by Henry Snure. There is another on Sec. 29, Union, owned by Michael Wilhelm. L. Svenson's is on Sec. 2, (S. E.) Houston.

The principal quarries at Hokah, now worked, are those of Nath. Whiteman, in the St. Croix sandstone, and Widow Prindle. The stone of Mr. Whiteman's quarry is a harsh, argillaceous sandrock, in layers a few inches thick, which becomes firmer on exposure. The best building stone lies higher up in the bluffs, and was opened

in Mt. Tom by the S. M. R. R. for the construction of their shops. It is from the St. Lawrence.

At La Crescent the public school-house was built of stone from Potter & Taylor's quarry, likewise in the St. Lawrence, north of La Crescent, in the edge of Winona county.

Lang's brewery, Sec. 28, Hokah, is a large stone building near the river, built of limestone from near the top of the bluff.

There is also a fine stone farm-house owned by Wm. Splitter, on Sec. 21, La Crescent, in Root river valley. The Nunnery, Sec. 28, La Crescent, was constructed of stone got from the bluffs near, including also that used for quicklime. These are all from the St. Lawrence:

On Winnebago creek (Sec. 22, Winnebago,) Mr. B. T. Barbour has a stone flouring mill.

O. T. West has a limestone quarry at Brownsville, which supplied heavy stone for the railroad and for other uses. Mr. Job Brown's, at the same place, furnished the limestone foundation for the public school-house.

The foregoing are a few of the stone buildings in the county, but there are several others which, though noticed in the progress of the survey, were not carefully located, and cannot be referred to. The St. Lawrence supplies by far the greater portion of the building-stone used in the county. There is not a single known workable quarry in the Shakopee, though exposed as favorably as the St. Lawrence. It is uniformly ignored. It is harder to work, has cherty lumps and siliceous concretions which not only disturb the bedding but render it difficult to cut into desired shapes, and is generally in thinner layers. The color is much the same as that of the St. Lawrence, being buff, or slightly salmon-colored, but the St. Lawrence is, where most used for building, also somewhat open or vesicular in texture. Thus mortar sets firmly upon it, and forms a sutured attachment. When the St. Lawrence stone is first taken out it cuts more easily than after exposure for a few weeks, a fact which seems to be true of nearly all good building stone.

Strength of Minnesota Building-stones.

A series of experiments has been carried on by Gen. Q. A. Gilmore, under the direction of Gen. A. A. Humphreys, Chief of Engineers, U. S. A., during several years, on the strength of various building-stones in the United States. The tests that have been made are conducted with great care and precision, and demonstrate the compressive strength, specific gravity and ratio of absorption, of the stones tested. In the report of the Chief of Engineers for 1875 is a general table giving results, and in that table are named the following building stones from Minnesota. Two-inch cubes were crushed under a powerful press.

Kind and Location.	Position in trial.	Strength of Specimen	Strength per Sq Inch.	Specific Gravity.	Weight of Cubic Feet.	Ratio of Absorption.	Remarks.
		Pounds.	Pounds.		Pounds.		
Granytes.							
Dark Syenytic granyte, Duluth	On bed.	70,200	16,950	2.780	173.7	1-711	
Dark Syenytic granyte, Duluth	On bed.	75,200	18,200	2.800	175.	0	
Dark Syenytic granyte, Duluth	On bed.	66,500	16,025	2.800	175.	0	
Dark Syenytic granyte, Duluth	On bed.	67,200	16,200	...	...	Slight.	Specific gravity not reported.
Dark Syenytic granyte, Duluth	On edge.	67,950	16,387	...	...	Slight.	Specific gravity not reported.
Light colored, St. Cloud	On bed.	63,900	15,200	2.69	168.2	1-239	
Light colored, St. Cloud	On edge	73,200	17,700	2.69	168.2	1-239	
Other Granytes.							
Dark granyte, Quincy, Mass		70,200	16,950	2.660	166.2	Very slow.	Cracked at 18,700 pounds.
Light granyte, Quincy, Mass		58,300	13,950	2.695	168.7	Very slow.	Cracked at 17,200 pounds.
Bluish-gray, Keene, N H	On bed.	40,200	9,575	2.656	166.0	1-300	Used in inside of New Capitol, Albany, N. Y.
Limestones.							
Pink limestone, Kasota, Minn	On bed.	42,000	9,900	2.630	164.4	1-56	The "Shakopee" limestone. Specimen cracked at 26,200 pounds
Pink limestone, Kasota, Minn	On edge.	45,900	10,875	2.630	164.4	1-56	Did not crack before crushing.
Light-buff, Frontenac, Minn	On bed.	24,200	5,450	2.325	145.3	1-28	The "St. Lawrence Limestone."
Light-buff, Frontenac, Minn	On edge.	30,200	6,975	2.325	145.3	1-28	The "St. Lawrence Limestone."
Other Limestones.							
White, Marblehead, Ohio	On bed.	44,200	10,450	2.4	150.	1-30	The "Corniferous."
White, Joliet, Ill	On bed.	57,800	13,850	2.54	158.8	1-91	The "Niagara "
Bluish-drab, Lemont Quarry, Cook Co., Ill	On bed.	47,200	11,200	2.645	165.3	1-89	
Sandstones.							
Purple sandstone, Fond du Lac, Wis*	On bed.	24,200	5,450	2.220	138.8	1-22	"Potsdam sandstone."
Purple sandstone, Fond du Lac, Wis	On bed.	24,100	5,425	2.220	138.8	1-22	"Potsdam Sandstone "
Purple sandstone, Fond du Lac, Wis	On edge	19,640	4,310	2.220	138.8	1-22	"Potsdam Sandstone."
Purple sandstone, Bass I., Wis	On bed.	21,000	4,650	2.040	127.5	1-15	"Potsdam Sandstone."
Purple sandstone, Bass I., Wis	On bed.	16,200	3 450	2.040	127.5	1-15	"Potsdam Sandstone "
Purple sandstone, Bass I., Wis	On edge.	16,350	3,487	2.010	127.5	1-15	"Potsdam Sandstone."

* These are probably from Fond du Lac, Minn.

Sand.

The St. Peter formation is excavated for mortar-sand by Jesse chofield, Sec. 14, Caledonia, and by John Burns on Sec. 26. his white sand is delivered at Caledonia village for $1.25 per load, occasionally for $1.50.

The St. Croix furnishes a similar sand near Mr. Kline's, Sec. 16, nion. These formations will supply a similar sand in any part the county where they are accessible, the layers in the St. Croix, owever, are about 200 feet below the top of the formation.

At Mr. Schofield's sand quarry, about a mile west of Caledonia, a large mass of "lamellar calcite," lying on the slope of the St. eter, and nearly covered by the loam. In that respect it is like similar mass seen near St. Charles, in Winona county, in 1872, id mentioned in the report for that year, but it seems more firm an that. This appears like a firm, very compact rock, consist- g of almost pure carbonate of lime, but somewhat colored. It is ainly massive, and striated, or laminated, but shows some crys- lline grains. It weathers into undulating or wavy, smooth rfaces. There is another much larger mass, weighing many ns on the land of Mr. Willard, a short distance west. These asses can be burnt into a purely white quicklime of great strength.

The age and origin of this calcite involves an interesting prob- m. When that piece was found in Winona county, in 1872, it as referred hypothetically to the Trenton Green Shales, or to the orn-out Cretaceous that may have covered that country, making of rock origin, either Lower Silurian or Mesozoic, but there is uch reason to believe these calcite massess are not referable to he rock *in situ*, but are of atmospheric origin, being, in short, the emains of immense travertine deposits from limy water running own the St. Peter slope from springs that once existed but are ow dry. They lie on the slope of the outcropping edge of the St. eter, just below the Green Shales which shed all the water that orks downward through the Upper Trenton limestone ; but they re also, so far as discovered, in regions where the Upper Trenton oes not now exist, the only remaining portion of the Trenton eing that which lies below the Green Shales. This is strikingly ie case near Caledonia, where the Trenton is reduced to mounds id tables, capping the St. Peter sandstone, very far isolated from ie main area of the Trenton. To suppose this calcite is due to prings caused by the Green Shales, a common phenomenon now Fillmore county, is to require the former existence of the Upper renton, with a considerable thickness of strata, over all the re- on of Caledonia, and extending far enough north and east to rnish drainage surface sufficient to maintain such springs. This not inconsistent with the history of geological changes, nor with ie lapse of time since the Trenton was elevated to the condition dry land. The present existence of isolated patches of the ower Trenton, both in Minnesota and Wisconsin, can only be xplained on the theory that the whole formation was once more rgely spread in horizontal strata over those states, than at pres- nt. Then an extension of the Lower Trenton so as to embrace

in one sheet of layers these isolated patches, is no more than enough to bring also the Upper Trenton into the region of these calcite masses. The present outlines, shape and position of the areas of the Lower Trenton, demonstrate that they are only the relics of once greater areas which have been eroded and removed slowly, and left as they are because they have been better protected against destructive agents. While Root river has been excavating the gorge in which it runs, 500 feet deep and two miles wide, the Trenton limestone, which at first may have extended as far northeast as to Hokah, has been slowly receding under the operation of denudation and surface drainage. These calcite masses, then, are relics of pre-glacial time, and perhaps of early pre-glacial time, since the last glacial epoch did not operate in Houston county so as to disturb the older surface.*

Brick.

The loam everywhere is suitable for making brick, which are uniformly red. The following establishments were seen:

Stephen Robinson, Money Creek; two miles south of the village

Fischer & Keller, Caledonia; began last year; burnt three kilns, and sold at $8.00 per thousand.

Brick were formerly made at La Crescent.

The Lutheran Society, at Spring Grove, manufacture on the spot a fine red brick from the loam taken out for foundations and basement of their large new church edifice.

Lime.

The Trenton and the St. Lawrence furnish all the quicklime made in Houston county. There are no extensive manufacturers, but the common pot-kiln is found at a number of points, by which enough is made to satisfy the local demands.

Ole Timro, sec. 24, Money Creek	St. Lawrence.
Gilbert Nelson, Spring Grove	renton.
Michael Blasen, 1½ mile west of Caledonia	Trenton.
Peter Kreer, ne. ¼ sec. 29, Mayville	St. Lawrence.
John Gross, 1 mile nw. from Brownsville	St. Lawrence.
John Molitor, 1 mile east of Caledonia	St. Lawrence.
George Timansen, Spring Grove	Trenton.
Ole Tostenson, Spring Grove	Trenton.
Wm. E. Potter, LaCrescent	St. Lawrence.
Samuel Pound, sec. 12, Hokah	St. Lawrence.

Lead.

It is a common belief at La Crescent, held by Mr. Knapp, Mr. Day and others, that the lead enterprise at Dresbach, mentioned by Dr. Owen in his final report on the geology of Wisconsin, Iowa and Minnesota, was a speculating job, got up for the purpose of creating an excitement and selling land. The reputed

* See the First Annual Report, p. 47.

iscoverers were men from Galena, Ill., and the lead found is elieved to have been brought from that place. The excitement oon died out, and all operations ceased the same season they egan, and have never been revived. Whether this be true or ot the rock, though not the same as that at Galena, is about the ame as that in which are the lead mines in Missouri.

Earthworks.

At La Crescent are a great many so-called *Indian Mounds.* Many have been graded away, but a good many still exist. They re on the brow of the drift-terrace, or lower bench, and none are nown on the upper, loam-terrace. They are, as usual, in rude ows, and about three feet high, some of them being four feet. When opened they have been found to contain human remains of nen of large stature, and it is said that in grading for the railroad a copper skillet and other trinkets were found at the depth of 18 eet below the surface.

Since the examination by Prof. James Hall, of the fossils of the Trenton, Black river and Birdseye limestones of New York, and the publication in 1846 of his large *pioneer volume* on the palæontology of the rocks of the United States, which makes the 1st volume of the New York State Palæontology, nothing so thorough as his work has been undertaken on the fossil contents of that geological horizon.

In Dr. Owen's report on the geology of Wisconsin, Iowa and Minnesota, which followed Prof. Hall's first volume, in 1851, a few species occurring at the falls of St. Anthony, and on Turkey river in Iowa, are described, and others are mentioned as identified at various other points in the northwest. The names applied are generally those of Prof. James Hall, and the identifications are based on those of the Trenton group of New York State.

In Foster & Whitney's Report on the Lake Superior Land District (1851) a few more species are described and figured by Prof. Hall, derived from the Trenton limestone in Michigan and Wisconsin.

In the First Canadian Decade (1859) by J. W. Salter, other species are described, particularly gasteropods, and there is also a full account of *Receptaculites occidentalis*, a genus which Prof. Hall first announced from the Trenton but failed to fully elucidate, owing to not having favorable specimens.

In the Third Canadian Decade (1858) Mr. Billings has named and figured a number of cystids from the Trenton rocks of Canada.

In the Fourth Decade (1859) the same eminent palæontologist describes the crinoids of the Trenton as found in Canada.

In 1861 was published by the legislature of Wisconsin a small volume containing descriptions of a number of new species of fossils from the Trenton of that state by Prof. Hall, who was then State Geologist of Wisconsin. This contribution to the palæontology of the Lower Silurian was printed only in the legislative documents, and is very rare.

The Reports of the New York State Cabinet, containing the

papers of the Curator, Prof. Hall, are many of them given largely to palæontology, and a number of them pertain to the Trenton limestone. These reports are issued annually, and now number 27.

In the Annual Reports of Progress of the Geological Survey of Canada, Mr. Billings also continued to add to our knowledge of the palaeontology of the Trenton, such material as was gathered in Canada. The reports for 1854, 1857 and 1858 contain matter relating to the Trenton. Subsequently to that he published his descriptions of fossils separately, and in 1865 was issued a fine volume on the Palæozoic fossils of Canada which was entirely the work of Mr. Billings, and contains figures of a number of Trenton species.

In 1863 appeared *The Geology of Canada*, which, however, only gives figures and names of species already described.

In 1868 was published the third volume of the publications of the Geological Survey of Illinois, which contains some descriptions of fossils from the Trenton and Galena formations, by Messrs. Meek and Worthen.

Meantime, in Tennessee, Prof. J. M. Safford had closely examined the fauna of the Trenton and Nashville series in that state, and without describing many new species he has given in his volume on the geology of that state much accurate information concerning its palæontology, as correlated to the same horizon in New New York state. This was published in 1869.

In 1874 appeared the first part of Vol. 2 of Palæozoic Fossils of Canada, by Mr. Billings, but it is mainly taken up with the Quebec Group.

By the aid of the foregoing works some progress has been made in the examination of the Trenton fossils of Minnesota. The specimens thus far examined are a part of those gathered by the Geological Survey of the State. The examination is far from complete. Indeed it has but just begun. Those have been named which are identifiable readily, leaving doubtful specimens, as far as the investigation has gone, to some future time when more pains can be taken to make sections and minute examinations. Moreover, there is a good collection of Trenton fossils in the cases of the Minnesota Academy, and another in the Academy at St. Paul, while one of the best collections of Galena fossils that have ever been made is in the possession of Mr. Frank Wilson, at Mantorville, who has kindly loaned them to the Survey.

It is hoped that with the aid of these collections, after a while, a complete account of the Trenton fauna may be made out for the Northwest, and that the study of this formation—so long neglected—may be made more easy and attractive.

The following species have been identified already. This list, though very incomplete, is here given that it may be seen how far the work has gone:

Cephalopoda.

Endoceras angusticameratum. Hall.
Endoceras magniventrum. Hall.
Orthoceras multicameratum. Con.
Endoceras proteiforme. Hall.
Endoceras proteiforme. Hall. Var strangulatum. Hall.
Endoceras distans. Hall.
Lituites undatus. Con.
Ormoceras tenuifilum. Hall.
Conularia Trentonensis. Hall.
Orthoceras bilineatum. Hall.
Orthoceras junceum. Hall.

10 species.

Gasteropoda.

Maclurea magna. Hall.
Murchisonia bellicincta. Hall.
Murchisonia bicincta. Hall.
Murchisonia perangulata. Hall.
Murchisonia angustata. Hall.
Pleurotomaria umbilicata. Hall.
Pleurotomaria ambigua. Hall.
Pleurotomaria lenticularis. Con.
Murchisonia subfusiformis. Hall.
Maclurea Logani. Sal.
Rhaphistoma lapicida. Salter (?)

11 species.

Brachiopoda.

Strophomena alternata. Con.
Strophomena tenuistriata. Sow. (a variety.)
Orthis testudinaria. Dal.
Strophomena fluctuosa. Bill.
Discina Pelopea. Bill.
Rhynchonella capax. Con. (increbescens of Hall.)
Orthis plicatella. H.
Orthis subquadrata. H.(?)
Strophomena nitens Bill.(?)
Lingula quadrata. Eich.
Orthis occidentalis. H.

Also undetermined species of Orthis Leptaena, Strophomena Chonet Lingula, Rhynchonella, and of the *Acephal*, Ambonychia.

11 species.

Polyp Radiates.

Petraia corniculum. H.
Chaetetes Lycoperdon. H.
Chaetetes petropolitanus. Pander.

3 species.

Crustacea.

Illaenus latidorsata. Hall (?)
Isotelus (Asaphus) gigas Hall.

2 species.

Protozoa.

Receptaculites occidentalis. Sal.
Receptaculites Oweni. Hall.

2 species.

ı addition to these there is a number of species that have been nined that have proved to be unidentifiable by the use of refer- ıs accessible, and some of them may prove to be new to science. f the foregoing species the following pertain to the Lower ıton or to the Green Shales that separate the Lower Trenton ı the Upper, and may probably be found in the neighborhood linneapolis, or along the bluffs of the river below the Falls of Anthony :

Endoceras angusticameratum. Hall.
Endoceras magniventrum. Hall.
Endoceras proteiforme. Hall.
Endoceras distans. Hall.
Chaetetes Lycoperdon. Hall.
Chaetetes petropolitanus. Pander.
Rhaphistoma lapicida. Salter(?)
Petraia corniculum. Hall.
Orthoceras junceum. Hall.
Orthoceras multicameratum. Con.
Orthoceras bilineatum. Hall. (Record doubtful.)
Isotelas gigas. Hall.
Orthis testudinaria. Dal.
Rhynchonella capax. Con.
Lingula quadrata. Eich.

ıe specimens from the locality of Minneapolis have not yet subjected to careful examination. There are known to be r species of brachiopods, graptolites and fucoids, besides gas- ɔods and corals.

ıe following have been identified from the Upper Trenton, including the Galena :

Orthoceras multicameratum. Con.
Lituites undatus. Con.
Endoceras distans. Hall.
Receptaculites occidentalis. Sal.
Endoceras proteiforme. Hall. Var strangulatum. Hall.
Ormoceras tenuifilum. Hall.
Maclurea magna. H.
Maclurea Logani. Salter.
Pleurotomaria Lenticularis. Con.
Chaetetes petropolitanus. Pander.
Murchisonia subfusiformis. H.
Murchisonia bellicincta. H.
Receptaculites Oweni. H.
Rhynchonella capax. Con.

ıe following are known from the Galena within the limits of State:

101510



Orthis plicatella. H.
Orthis subquadrata. H.(?)
Strophomena nitens. Bill.(?)
Orthis occidentalis. H.

'rof. N. H. Winchell:

My Dear Sir :—I have the pleasure of reporting the chemical ork on the Geological Survey for the past year as consisting of a omplete analysis of the so-called, Russell Mineral Spring, in Mineapolis ; four specimens of coal and their ashes the serial numers of which are 11, 12, 13 and 14 ; No. 15, a sort of clay, and a tone known as the St. Lawrence limestone, of which there were wo specimens numbered 30 and 31. I also report the analyses nade for Messrs. Kindred and Culver in the fall of 1875.

The process of analysis employed for the coals was the same as hat used by myself for the analysis of some 25 specimens belonging to the Geological Survey of California. The specific gravity was first determined by sifting the dust from the finely granulated coal and weighing in a sp. gr. flask, after standing under water at east 12 hours. One gramme was then weighed in a platinum crucible and dried at a temperature of 215°-220° Fahr. until it ceased o lose weight. The loss is water.*

The residue was then heated over a Bunsen's burner for 3.5 minutes, and then over a blast lamp for the same length of time, and veighed. The loss was considered to be volatile combustible matter. The residue was burned to an ash and the ash weighed. The oss from combustion was considered to be non-volatile combustible material, or fixed carbon.

In conformity with your wishes I also made a quantitative analysis of the ashes of each of these coals.

The coals are quite unlike. Nos. 11 and 12 are semi-cannel coals. No. 13 consists of a mass of clay containing carbonaceous matter. No. 14 consists of an earthy mass, chiefly silica containing fragments of mineral charcoal.

*The question has been raised whether or no this loss be water. Very carefully conducted experiments were made during my research upon the California coals, to ascertain if the coal was oxidized by prolonged heating at the temperature above mentioned. The amount of water escaping was absorbed by chloride of calcium and weighed. It exactly corresponded to the loss experienced when the experiment was conducted as described above, and no oxidation products could be detected.

No. 11 is homogeneous and brittle, of a dull black color, and cracks in a dry atmosphere. When heated it is non-caking, the pieces retaining their form and size, and in this respect it resembles some of the cretaceous coals of the Pacific coast. The results of analysis are as follows:

Specific gravity	1.441	
Water	13.53	per cent.
Volatile combustible matter	54.11	"
Fixed carbon	29.49	"
Ash	2.87	"
	100.00	"
The ash contained—		
Insoluble silicic acid, etc	3.698	per cent.
Soluble silicic acid	14.159	"
Sulphuric acid	23.363	"
Ferric oxide and alumina	23.419	"
Lime	7.592	"
Magnesia	16.055	"
Carbonic acid, chlorine, alkalies, etc	11.714	"
	100.000	"

The total amount of combustible matter in this coal is 83.60 per cent.

No. 12 in some respects resembled No. 11. It is a semi-cannel in appearance, very friable in dry air, and non-caking. The results of analysis are as follows:

Specific gravity	1.425	
Water	12.70	per cent.
Volatile combustible matter	38.32	"
Fixed carbon	45.61	"
Ash	3.37	"
	100.00	"
The ash contained—		
Insoluble silicic acid, etc	8 338	per cent.
Soluble silicic acid	22.963	"
Sulphuric acid	19.674	"
Ferric oxide and alumina	20.006	"
Lime	16.353	"
Magnesia	3.946	"
Carbonic acid, chlorine, alkalies, etc	8.720	"
	100.000	"

The total amount of combustible matter in this coal is 83.93 per cent.

No 13 is a specimen of dark colored clay containing an unusual amount of organic combustible matter, not enough, however, to give it any value as fuel. It burns to a very light-colored ash consisting largely of alumina, and would therefore in all probabilty make very good brick if sufficient sand were mixed with it. The results of analysis were as follows:

Specific gravity	1.968	
Water, Volatile combustible matter, Fixed carbon	29.55	per cent.
Ash, consisting of clay	70.45	"
	100.00	"

The ash contained—

Insoluble portion, consisting of insoluble alumina and silicic acid	92.751	per cent.
Soluble silicic acid	.490	"
Sulphuric acid	.282	"
Ferric oxide and alumina	2.894	"
Lime	1.076	"
Magnesia	.348	"
Undetermined matters	1.159	"
	100.000	

No. 14 consisted of a soft, siliceous rock, containing small fragments, grains and specks of mineral charcoal. The results of analysis are as follows:

Specific gravity	2.141	
Water and combustible matter	26.54	per cent.
Ash	73.46	"
	100.00	"

The ash contained—

Insoluble matter, chiefly silicic acid	96.549	per cent.
Soluble silicic acid	0.836	"
Sulphuric acid	0.178	"
Ferric oxide and alumina	0.257	"
Lime	1.023	"
Magnesia	0.462	"
Undetermined matters	0.695	"
	100.000	

No. 15 is a dull-green, amorphous mineral, unctuous and soapy to the touch. Fracture uneven, coarsely granular. Hardness 1.5. Easily cut with a knife, giving a smooth surface. Specific gravity 2.562. Lustre dull, waxy, with very minute pearly scales. Color mottled, dull-green to grayish-green, opaque, scales translucent. When wetted it absorbs water and softens, but does not become plastic.

In closed tube it gives water. B.B. infusible. Gives blue color with cobalt, which is indistinct from excess of iron. Is decomposed by hydrochloric acid, leaving a white insoluble residue containing only a trace of iron. The oxidation of the iron varies according to the extent of the exposure. The following are the mean results of three closely concordant analyses:

SiO_2	37.88	per cent.
Fe_2O_3	15.78	"
Al_2O_3	26.96	"
MgO	1.74	"
K_2O, Na_2O	0.95	"
H_2O	15.88	"
	99.16	"

A trace of lime was not determined.

These results show the mineral to be allied to Fahlunite, var. Huronite of T. S. Hunt. See Dana's Mineralogy, Ed. 1870, p. 485. It is doubtless one of the numerous decomposition products of a ferruginous Feldspar.

Nos. 30 and 31 are pieces of the St. Lawrence limestone. This stone consists of a hard, siliceous, magnesian limestone containing sufficient iron to give it an ocherous shade of color with yellowish streaks. It also contains angular grains of quartz and small grains of a green mineral quite uniformly distributed through the rock. These grains are of all sizes from that of a large pin's head to those of scarcely preceptible dimensions. They are irregularly spherical in form, sometimes slightly flattened, or elongated. Cold commercial hydrochloric acid dissolves all of the constituents of the rock except the grains of quartz and the green grains. By sifting and careful sorting, the largest of the green grains may be obtained quite pure. The specific gravity of these grains is 3.634—Hardness about 2.0. B. B. infusible becoming brown from oxidation of iron. In the closed tube gives water becoming more or less oxidized. The following are the mean results of three analyses :

SiO_2	48.20	per cent.
FeO	27.09	"
Al_2O_3	6.94	"
K_2O	7.54	"
Na_2O	1.02	"
H_2O	8.72	"

These characteristics and results give a variety of Glauconite not decomposed by hydrochloric acid. See Dana's Mineralogy, Ed. 1870, p. 462.

Russell Mineral Spring Water. This water flows from a spring in the cellar of the house at present occupied by Perkins Russell, Esq., on the corner of Fifth street and Fifteenth avenue S. E., in this city. The flow of the spring is very uniform throughout the year and the volume is copious, bubbling up in the center of a curbed area about four feet in diameter. On exposure to the atmosphere the water deposits sesqui-oxide of iron. No gas escapes from super-saturation. The water is very clear and sparkling, with a slight green color and the taste of a dilute solution of hydrosulphuric acid gas.

Analysis showed that one U. S. wine gallon of 231 cubic inches contains of,

		Grains.
Potasium chloride,	K Cl	0.170161
Sodium chloride,	Na Cl	1.226701
Calcium chloride,	$Ca Cl_2$	0.393765
Calcium carbonate	$Ca CO_3$	10.060996
Calcium sulphate,	$Ca SO_4$	0.867690
Calcium Phosphate,	$Ca_3 (PO_4)_2$	0.171380
Magnesium carbonate,	$Mg CO_3$	4.371058
Iron proto-carbonate,	$Fe CO_3$	0.169227
Manganese proto-carbonate,	$Mn CO_3$	0.032561
Silicic oxide,	$Si O_2$	1.393182
Organic matter,		0.208340
Sodium biborate,		A trace.
Potassium nitrate,		A trace.
Ammonium chloride,		A trace.
Calcium fluoride,		A trace.
Barium carbonate,		A trace.
Barium sulphate,		A trace.
Total solid matter,		19.065061
Specific gravity at 60° Fahr.		1.000638
Temperature,		45.5° Fahr.

At that temperature one gallon contains of

Carbonic acid gas,	CO_2	41.037432 C. inches.
Of which is combined to form bicarbonates,		25.651171 C. inches.
Leaving in solution,		15.386261 C. inches.

The water also contains an amount of hydrogen sulphide ($H_2 S$), varying in amount at different times from a trace to a few cubic inches per gallon.

These results give a water of somewhat peculiar character, yet not sufficiently remarkable in any respect to lead one to expect unusual results to follow its use. The amount of solid matter is small and consequently all of the ingredients present are found in small proportion; yet we find, on comparing these results with the analysis of other waters, that the amount of calcium phosphate present is relatively large. The reputation which the water has attained as a remedial agent, may be, in part, due to the presence of this salt, or it may be due to the peculiar combination presented by the simultaneous presence of phosphate of lime, proto-carbonate of iron and sulphide of hydrogen.

It may be said, however, that the causes producing certain physiological effects are very obscure, and when these effects are observed to follow the use of complex mixtures dissolved in large quantities of water, but little satisfaction can be gained from theoretical speculations that attribute them to the presence of one or the other ingredient of the mixture. But little more can be said than that the water contains small quantities of substances that

give, when found in large proportions, the specific characters to seltzer, chalybeate, and white-sulphur springs, and that its use in many instances has been attended with beneficial results.

In accordance with your request, that I should furnish you the results of the analyses that were made in the fall of 1875 for Messrs. Kindred and Culver, I submit the following:

I. Three specimens supposed to contain silver were sent to Dr. P. B. Rose to be assayed. The first two were from J. B. Culver, Esq., of Duluth, and were reported as not containing silver. The third specimen was from C. F. Kindred, Esq., of Brainerd. It was reported as containing "52.32 oz. of silver to the ton of ore, which at $1.30 per oz. = $68.01 per ton."

II. A sample of iron ore, supposed to contain tin, from the neighborhood of Duluth, was sent to Prof. E. W. Morley, of Hudson, Ohio, a gentleman of large experience on iron assays. He reported two assays as yielding iron, 16.19 per cent. and 16.17 per cent. "Tin not present in any appreciable quantity. The ore appeared to contain quite a notable quantity of Titanium. Titanium is now supposed to be injurious. * * The amount of iron in the ore is so small that iron produced from it could hardly compete with richer ores, even if flux and coal were both near at hand. One would not like to say the ore is valueless without knowing the relative amount of silica and calcium in the ore; but the probability that they are in such proportions as to render the addition of a flux needless, is very slight."

Another sample of iron ore from near Duluth, was sent Prof. Morley with instructions to determine the quantity of any thing he might find in it of commercial value. After giving the details of the process of analysis, he says: "You will see that everything of any commercial value is pretty thoroughly excluded. It is an iron—magnesium—sodium silicate; with not enough iron to make it of value as an iron ore."

The first mentioned iron ore resembles an iron ore found in the northern part of Rhode Island, where it occurs in a protruded mass, in some respects resembling porphyry.

Respectfully submitted,

S. F. PECKHAM,
State Chemist.

MINNEAPOLIS, Jan. 9, 1877.

V.

BOTANY.

The survey has received a hearty response to the following circular, which was issued in conformity with the instructions of the Regents, in the spring of 1876:

THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.

(BOTANY.)

To the Botanists of the State:

At the annual meeting of the Board of Regents, held in St. Paul in December, 1875, action was taken ordering the commencement of a thorough and systematic examination of the flora of the state. This was done in conformity to the law ordering a geological and natural history survey of the state, and placing it in charge of the Regents of the University. One clause of that law reads as follows:

"SEC 3. The natural history survey shall include, first, an examination of the vegetable productions of the state, embracing all trees, shrubs, herbs and grasses native or naturalized in the state; second, a complete and scientific account of the animal kingdom as properly represented in the state, including all mammalia, fishes, reptiles, birds and insects."

In the prosecution of this examination it is expected that the Regents will have the assistance of the botanists of the state, and it is for their information that the following suggestions are made concerning the collection and preservation of information, and especially of botanical specimens.

1st. Make as full notes as possible on the flora of your own locality, not only naming species, but mentioning peculiarities and variations of structure, habitat, color, and relative abundance. Recollect that there is no published text book that professes to give an account of the flora of the country west of the Mississippi in this latitude, and that you are very largely an independent observer. Therefore repeated verifications of an observed variation or peculiarity, or of a species not named in the familiar text-books, should be made *before reporting such observation as a fact.*

2d. Collect and preserve as many specimens as possible. They will exemplify the local flora of your region, and will serve as duplicates for exchange with other portions of the state and with foreign botanists. The most valuable portion of your contribution to the survey will be, after all, the collections which you may make and forward for careful identification.

3d. It is the design of the Regents to collect together at the University, a complete representation of the plants of the state as ordered by the law, and to have them so arranged and exhibited that they can be seen for

comparison by any of the botanists of the state that may wish to examine them.

4th. For aid in the study of the flora of the state, the following works will be useful:

Gray's *Manual of Botany.*

Torrey & Gray's *Flora of North America*, 2 vols., to *Lobeliaceæ.*

De Candolle's *Prodromus*, 18 vols., down to *Endogenae.*

U. S. Geological Exploration of the Fortieth parallel. Vol. V, Botany. (Watson.)

Pacific R. R. Reports.

Transactions of the St. Louis Academy.

Proceedings of the American Academy, Philadelphia.

Catalogue of the Plants of Minnesota, by I. A. Lapham, published in the Annual Report of the State Horticultural Society for 1875. Furnished by the Secretary of the Society.

Hayden's *Nebraska Plants.*

Hooker's Fl. Bot. Am., 2 vols.

Flora of Colorado, I vol., Porter & Coulter.

Nuttall's Genera, 2 vols.

Bentham's Genera, 4 parts.

5th. It is evident that there is no botanist, nor even any public library in the state that possesses the books necessary for the thorough study and satisfactory determination of the species of our flora. Within certain limits our flora can be studied, but the burden of our first efforts must be the collection of specimens. Their exhaustive study can only be done by experts, with the fullest facilities for comparison.

6th. The present design of the survey is to act as a means of communication between botanists of the state, to enable them to compare specimens, and as a depository for duplicates. To this end exchanges will be made with such as desire to compare species, and any aid or information will be rendered that it is possible to give. Lists of the local flora in different parts of the state should be made out as thoroughly as possible, to judge of the distribution of species. The areas that are covered with timber in the various counties, or townships, and the kinds of trees, should be stated. It is highly desirable that a local botanist be assigned to the working up of each county. For this purpose, the survey should be furnished with the names of such botanists as are known to be interested in our state flora. Annual reports made by such local botanists would indicate the progress of the work.

N. H. WINCHELL.

THE UNIVERSITY OF MINNESOTA,
May 1st, 1876.

The survey has received several hundred specimens representing the flora of the state, and others have been gathered by Mr. Leonard and Mr. Herrick, assistants on the survey. Nothing systematic has been attempted in the way of identifications, but through the kindness of others, chiefly Mr. O. E. Garrison, of St. Cloud, and Dr. A. E. Johnson, of Minneapolis, valuable assistance has been rendered in determining our local flora.

FUNGI.

BY DR. A. E. JOHNSON.

Prof. N. H. Winchell:—I believe no attempt prior to this has been made to collect and list the Mycologic Flora of Minnesota. As a small contribution to the Natural History of Minnesota, I present the following list of plants, in the Mycologic Flora of our state, for such use as you may be pleased to make of it.

The list has been collected mainly from Hennepin county ; some from Anoka, Ramsey and Wright counties.

I have placed the Gen. or Sub-Gen. before each species; as for example, Sub-Gen. 1. *Amanita*. Hence, in reading *Agaricus vaginatus*, the word *Amanita* should be supplied thus: *Agaricus* (Amanita) vaginatus. *Bull*. And so with all the species under each Gen. or Sub-Gen. Following the specific name of the species are initials or letters used by botanists to designate the name of the author of the species, and immediately following is the common name of the plant if it has received one ; then follow such words as, wood, woods, ground, sticks, stumps, epiphytal, terrestrial, etc., indicating the habitat, and lastly the month or months in which the plant is found in our climate. If there is but one month named, the plant has only been observed in that month, but if two months are named, as June, Nov. the plant has been observed in both months, and most always during the intervening months:

DIVISION 1. Sporifera.

FAMILY 1. Hymenomycetes.

ORDER 1. Agaricini.

SERIES 1. Leucospori. Spores white.

SUB-GEN. Amanita *Pers.*

GEN. Agaricus. *L.*

1. Agaricus vaginatus. *Bull.* Slick Amanita. Woods. August.
2. A. Ceciliae. *B. & Br.* Grey, ringless Amanita. Woods. Aug., Sept.
3. A. adnatus. *Smith.* Adnate-gilled Amanita. Woody places. Aug.
4. A. vernus. *Bull.* Spring Amanita. Woods, open places. June to Aug.
5. A. phalloides. *Fr.* Stinking Amanita. Woods. August. Nov.
6. A. mappa. *Batsch.* Delicate Amanita. Under trees. Poisonous.
7. A. muscarius. *L.* Fly Amanita. Thin woods. Aug. & Sept. Poisonous.
8. A. excelsus. *Fr.* Tall Amanita. Woods. Aug. and Sept.
9. A. pantherinus. *D. C.* Spotted Amanita. Woods and open ground.
10. A. asper. *Fr.* Rough Amanita. Woods. June to Sept.

SUB-GEN. Lepiota. *Fr.*

11. A. procerus. *Scop.* Parasol mushroom. Woods. Aug. to Sept.
12. A. excoriatus. *Schæff.* Flaky Lepiota. Woods. May to Sept.
13. A. gracilentus. *Krombh.* Slender Lep. Ground. Sept. Edible.
14. A. acutesquamosus. *Wm.* Squarrose Lepiota. Ground. July.
15. A. clypeolarius. *Bull.* Fragrant Lepiota. Woods. Ju.
16. A. Americanus. *Peck.* Prairies. Aug. to Sept.
17. A. cristatus. *Fr.* Stinking Lepiota. Woods, fields. Aug.
18. A. naucinus. *Fr.* Large spored Lepiota. Woods. Aug. to Sept.
19. A. granulosus. *Batsch.* Granular Lepiota. Forests. July.
20. A. polystictus. *Berk.* Little Brown Lepiota. Ground. July.

SUB-GEN. Armillaria. *Fr.*

21. A. melleus. *Vahl.* Honey-coloured Armillaria. W. Aug to Sept.



32. A. dealbatus. *P.* Ivory Clito
33. A. giganteus. *Fr.* Giant Clit
34. A. cyathiformis. *Fr* Cup-sha
35. A. laccatus. *Scop.* Waxy Cli
36. A. cerussatus. *Fr.* White le
37. A. radio-zonaria. *n. sp.* Rad

A full description in Bulletin of th
ences for 1876.

SUB GEN.

38. A. ostreatus. *Jacq.* Oyster
39. A. seratinus. *Schrad.* Yellov
40. A. mastrucatus. *Fr.* Imbric
41. A. atrocœruleus. *Fr.* Blue-b
42. A. sulfuroides. *Peck.* Pine l
43. A. serotinoides. *Peck* Trun

SUB-GEN.

44. A. radicatus. *Relh.* Rooting
45. A. velutipes. *Curt.* Velvet-s
46. A. confluens. *P.* Confluent
47. A. cirrhatus. *Schum.* Cirrh
48. A. tuberosus. *Bull.* Tubero
49. A. acervatus. *Fr.* Tufted C
50. A. xanthopus. *Fr.* Yellow-s
51. A. dryophilus. *Bull.* Wood
52. A. exsculptus. *Fr.* Sulphur-
53. A. plexipes. *Fr.* Twisted C
54. A. stipitarius. *Fr.* Fibrillos

SUB-GEN.

55. A. praelongus. *Peck.* Epiph

A. epipterygius. *Scop.* Yellow-stem Mycena. July to Aug.
A. stylobates. *P.* Discoid Mycena. Epiphytal. Woods. Aug.
A. corticola. *Schum.* Bark Mycena. July, Aug.
A. capillaris. *Schum.* Capillary mycena. Leaves. Aug.

SUB-GEN. Omphalia. *Fr.*

A. pyxidatus. *Bull.* Variable Omphalia. Ground. July.
A. affricatus. *Fr.* Hairy Bog Omphalia. Ground. July.
A. muralis. *Sow.* Wall Omphalia. Ground. July.
A. umbilliferus. *L.* Common Omphalia. Ground. July. Sept.
A. rufulus. *B. & Br.* Reddish Ompahlia. Ground. July.
A. campanella. *Batsch.* Tawny Omphalia. Larch swamps.
A. chryseus. *Peck.* Logs in woods. August.
A. fibula. *Bull.* Button Omphalia. Ground. June, Oct.
A. gracillimus. *Weinm.* Delicate Omphalia. Epiphytal. Aug.
A. integrellus. *P.* Little-white Omphalia. Epi. Aug., Sept.

SERIES. 2. Hyporhodii. *Fr.*

SUB-GEN. Volvaria. *Fr.*

A. bombycinus. *Schæff.* Silky Volvaria. Epiphytal. July, Aug.
A. volvaceus. *Bull.* Stove Volvaria. Ground. July, Aug.
A. Taylori. *Berk.* Taylor's Volvaria. Ground. Aug., Sept.
A. gloiocephalus. *Fr.* Umbonate Volvaria. Ground. June.

SUB-GEN. Chamæota. *Smith.*

A. cretaceus. *Fr.* Chalky Chamæota. Ground. Aug.

SUB-GEN. Pluteus. *Fr.*

A. cervinus. *Schæff.* Fawn Pluteus. Ground. May, Oct.
A. nanus. *P.* Mealy Pluteus. Logs in woods. Aug.
A. petasatus. *Fr.* Broad-capped Pluteus. Epiphytal. Aug.
A. leoninus. *Schæff.* Yellow Pluteus. On wood. Aug., Oct.
A. chrysophæus. *Schæff.* Dingy Pluteus. On wood. Aug.
A. phlebophorus. *Ditm.* Veined Pluteus. On wood. Aug.

SUB-GEN. Entoloma. *Fr.*

A. strictior. *Peck.* Ground. Sept., Oct.
A. sinuatus. *Fr.* Woods. Ground. Poisonous. July.
A. prunuloides. *Fr.* Plum-like Entoloma. Woods, ground. Sept.
A. helodes. *Fr.* Moor Entoloma. Ground, woods. Sept.
A. repandus. *Bull.* Repand Entoloma. Ground, woods. July.
A. ardociacus. *Bull.* Meadow Entoloma. Ground, woods. Sept.
A. sericellus. *Fr.* Silky Entoloma. Woods. Aug., Sept.
A. rhodopolius. *Fr.* Rosy Entoloma. Ground, woods. Aug., Sept.
A. costatus. *Fr.* Costate Entoloma. Ground. Sept.
A. cuspidatus. *Peck.* Swamps. Sphagnus marshes. Sept.

SUB-GEN. Clitopilus. *Fr.*

A. prunulus. *Scop.* Plum Clitopilus. Woods, ground. Season.
A. cretatus. *Berk.* Chalky Clitopilus. Woods, ground. Aug., Sept.
A. noveborasensis. *Peck.* Dingy white Clitopilus. Ground. Aug.
A. Woodianus. *Peck.* On ground, and wood. Sept.
A. undatus. *Fr.* Waved Clitop. Aug., Sept.

SUB-GEN. Claudopus. *Smith.* Seem. Journal.

103. A. euosmus. *Berk.* Tarragon Clau. Wood. June.
104. A. depluens. *Batsch.* Ground Clau. Ground. Sept.

SUB-GEN. Leptonia. *Fr.*

105. A. chalybæus. *P.* Steel-blue Leptonia. Prairies. July, Sept.
106. A. incanus. *Fr.* Hoary Leptonia. Prairies. Dayton. Aug.

SUB-GEN. Nolanea. *Fr.*

107. A. pascuus. *P.* Pasture Nola. Wet prairies. June.
108. A. rufo-carneus. *Berk.* Red-brown Nola. Marshes. Aug., Sept.
109. A. Babingtonii. *Blox.* Babington's Nola. Woods. Sept.
110. A. conicus. *Peck.* On rotton wood. Swamps. Aug.
111.* A. delicatulus. *Peck.* Delicate Nola. Larch swamp. Aug.
112. A. Clintonianus. *Peck.* Clinton's Nola. Swamps. Aug.

SERIES 3. Dermini. *Fr.*

SUB-GEN. Pholiota. *Fr.*

113. A. præcox. *P.* Spring Phol. Prairies. May.
114. A. comosus. *Fr.* Hairy Phol. Decaying trunks. Aug.
115. A. squarrosus. *Mull.* Scaly Phol. Trunks. Aug.
116. A. flammans. *Fr.* Yellow scaly Phol. Ground. June.
117. A. temnophyllus. *Peck.* Brownish Phol. Ground. June, July.

SUB-GEN. Hebeloma. *Fr.*

118. A. punctatus. *Fr.* Ground in woods. Sept.
119. A. crustuliniformis. *Bull.* Ring Hebeloma. Woods. Sept.
120. A. fastibilis. *Fr.* Ochrey Hebe. Woods. July-Oct. Common.
121. A. stellatosporus. *Peck.* Stellate Hebeloma. Ground. Sept.
122. A. griseo-cabrosus. *Peck.* Rough Hebeloma. Popple groves. Sept.
123. A. illicitus. *Peck.* Smooth Hebeloma. Popple groves. Sept.
124. A. ascophorus. *Peck.* Viscid Hebeloma. Burned ground. Sept.
125. A. mutatus. *P.* Changeable Hebeloma. Ground. July, Aug.
126. A. pyriodorus. *P.* Pear-scented Hebeloma. Woods. Sept.
127. A. obscurus. *P.* Violet Hebeloma. Ground. July.
128. A. flocculosus. *Berk.* Flocculose Hebeloma. Ground. Sept.
129. A. deglubens. *Fr.* Peeling Hebeloma. Woods. Aug., Sept.
130. A. fastigiatus. *Fr.* Peaked Hebeloma. Woods. July.
131. A. rimosus. *Bull.* Cracked Hebeloma. Ground. June, Sept.
132. A. trechisporus. *Berk.* Rough-spored Hebeloma. Ground. Aug.
133. A. auricomus. *Batsch.* Golden-haired Hebeloma. Woods. July.
134. A. floculentus. *Poll.* Woolly Hebeloma. Ground. July.

SUB-GEN. Flammula. *Fr.*

135. A. polychrous. *Berk.* Reddish Flammula. Ground, wood. Aug., Sept.
136. A. gummosus. *Lasch.* Viscid Flammula. Wood. July.
137. A. sapineus. *Fr.* Bright-Spored Flam. Ground and wood. Aug.

SUB-GEN. Crepidotus. *Fr.*

138. A. mollis. *Schæff.* Soft Crepidotus. On wood. July-Oct.

SUB-GEN. Naucoria. *Fr.*

139. A. semiorbicularis. *Bull.* Half-round Naucoria. Dung. June.

140. A. vernalis. *Peck.* Decaying wood. June.
141. A. lignicola. *Peck.* Decaying wood. June.
142. A. erinaceus. *Fr.* Hedgehog Naucoria. Wood. Nov.

SUB-GEN. Galera. *Fr.*

143. A. ovalis. *Fr.* Oval Galera. Cow-dung. Aug.
144. A. tener. *Schæff.* Slender Galera. Dung. July-Oct.
145. A. sparteus. *Fr.* Meadow Galera. Mossy ground. June.
146. A. hypnorum. *Batsch.* Moss-loving Galera. July. Sept.
147. A. sphagnorum. *Pers.* Bog-moss Galera. July, Sept.

SUB-GEN. Tubaria. Smith. Journ., 1870.

148. A. inquilinus. *Fr.* Little Tubaria. On wood, swamps. June, Sept.
149. A. furfuraceus. *P.* Mealy Tubaria. Chips, wood. July, Sept.

SERIES 4. Praetellæ. *Fr.*

SUB-GEN. Psalliota. *Fr.*

150. A. campestris. *L.* Common Mushroom. Ground. August.
Var. pratensis. *Vitt.* Rich muck. Aug.
Var. silvicola. *Vitt.* Ramsey and Wright counties. Aug.
151. A. silvaticus. *Schæff.* Wood Psalliota. Woods. Aug.
152. A. Johnsonianus. *Peck.* Woods. Sept.

SUB-GEN. Pilosace. *Fr.*

153. A. eximius. *Peck.* Decaying logs in woods. Sept.

SUB-GEN. Stropharia. *Fr.*

154. A. stercorarius. *Fr.* Dung Stropharia. May, Sept.
155. A. semiglobatus. *Batsch.* Semiglobose Stropharia. June, Sept.

SUB-GEN. Hypholoma. *Fr. Hab.* Generally on stumps.

156. A. sublateritius. *Fr.* Brick-red Hypholoma. Sept.
157. A. fascicularis. *Hud.* Tufted Yellow Hypholoma. Sept.
158. A. lacrymabundus. *Fr.* Weeping Hyph. July, Nov.
159. A. velutinus. *P.* Velvety Hyph. Trunks. July.
160. A. perplexus. *Peck.* Ground about stumps. Sept.
161. A. phyllogenus. *Peck.* Fallen leaves. July.

SUB-GEN. Psilocybe. *Fr. Hab.* Mostly on the ground.

162. A. limicola *Peck.* Aug., Sept.
163. A. spadiceus. *Schæff.* Bay Psilocybe. Wood. Ground. Aug.
164. A. cernuus. *Mull.* Nodding Psilocybe. Wood. Ground. Sept.
165. A. fœnisecii. *P.* Brown Psilocybe. Ground. Sept.

SUB-GEN. Psathyra. *Fr. Hab.* Ground. Wood.

166. A. mastiger. *Berk & Br.* Peaked Psathyra. Ground. Aug., Sept.
167. A. corrugis. *P.* Wrinkled Psathyra. Ground. Aug.
168. A. obtusatus. *Fr.* Obtuse Psathyra. Ground. June.

SERIES 5. Coprinarii. *Fr.* Spores black.

SUB-GEN. Panæolus. *Fr.* Mostly on dung.

169. A. separatus. *L.* Ochrey Panæolus. June, Sept.
170. A. leucophanes. *B. & Br.* Shiny-White Panæolus. May, Aug.
171. A. fimiputris. *Bull.* Dark-gray Panæolus. June, Aug.
172. A. campanulatus. *L.* Campanulate Panæolus. June, Aug.
173. A. papilionaceus. *Bull.* Butterfly Panæolus. June, July.
174. A. solidipes. *Peck.* July.
175. A. fimicola. *Fr.* Dung Panæolus. June.

SUB-GEN. Psathyrella. *Fr.*

176. A. gracilis. *Fr.* Slender Psathyrella. Sept.
177. A. pronus. *Fr.* Stooping Psathyrella. Ground. Sept.
178. A. atomatus. *Fr.* Sprinkled Psathyrella. Manure. June, July.
179. A. disseminatus. *Fr.* Clustered Psathyrella. Woods. July, Sept.
180. A. odoratus. *Peck.* Manure heaps. May, June.

GEN. 2. Coprinus. *Fr.*

181. C. comatus. *Fr.* Shaggy Coprinus. Rich ground. Sept.
182. C. atramentarius. *Fr.* Inky Coprinus. Dung. June, July.
183. C. fuscescens. *Fr.* Brownish Coprinus. Wood. June, July.
184. C. picaceus. *Fr.* Magpie Coprinus. Ground. Sept.
185. C. similis. *B. & Br.* Striate Coprinus. Wood. Sept.
186. C. fimetarius. *Fr.* Shaggy-dung Coprinus. June, July.
187. C. tomentosus. *Fr.* Downy Coprinus. Dung. May, June.
188. C. niveus. *Fr.* Snowy Coprinus. May, June.
189. C. micaceus. *Fr.* Glistening Coprinus. May, Sept.
190. C. deliquescens. *Fr.* Deliquescent Coprinus. June.
191. C. lagopus. *Fr.* Hare's foot Coprinus. Dung. July.
192. C. radiatus. *Fr.* Delicate Coprinus. Dung. May, June
193. C. ephemerus. *Fr.* Ephemeral Coprinus. May, June.
194. C. insignis. *Peck.* About roots of trees. July, Aug
195. C. angulatus. *Peck.* Ground in woods. Aug., Sept.
196. C. plicatilis. *Fr.* Rich ground. June, July.
197. C. hemerobius. *Fr.* Collared Coprinus. July.
198. C. silvaticus. *Peck.* Ground. Sept.
199. C. semilanatus. *Peck.* Dung. Aug.

GEN. 3. Bolbitius. *Fr.* Manure, rich soil.

200. B. Boltoni. *Fr.* Bolton's Bolbitius. Dung. June, Sept.
201. B. fragilis. *Fr.* Fragile Bolbitius. Epiphytal. May, Aug.
202. B. titubans. *Fr.* Wavering Bolbitius. Ground. Forest. Open. Ju., Oct.
203. B. apicalis. *Smith.* Two-coloured Bolbitius. Ground. June, July.
204. B. nobilis. *Peck.* Noble Bolbitius. Ground. Woods. Sept.

GEN. 4. Cortinarius, *Fr.*

SUB-GEN. 1. Phlegmacium. *Fr.*

205. C. varius. *Fr.* Variable Cort. Ground. Woods. Aug., Sept.
206. C. cyanipes. *Fr.* Blue-stemed Cort. Woods. July, Aug.
207. C. russus. *Fr.* Ruddy Cort. Woods. Sept.
208. C. coloratus. *Peck.* Amongst moss. Larch swamps. Sept.
209. C. communis. *Peck.* Woods. Sept.
210. C. multiformis. *Fr.* Multiform Cort. Woods. Sept.
211. C. glaucopus. *Fr.* Brown-zoned Cort. Sept.

212. C. callochrous. *Fr.* Tawny-viscid Cort. Woods. Aug., Sept.
213. C. cœrulescens. *Fr.* Azure-blue Cort. Woods. Sept.
214. C. turbinatus. *Fr.* Top-shaped Cort. July, Sept.
215. C. scaurus. *Fr.* Club-footed Cort. Woods. Sept.
216. C. corrugatus. *Peck.* Woods. June.

SUB-GEN. 2. Myxacium. *Fr.*

217. C. collinitus. *Fr.* Smeared Cort. Woods. Sept.
218. C. sphærospôrus. *Peck.* Woods. Sept.

SUB-GEN. 3. Inoloma. *Fr.*

219. C. violaceus. *Fr.* Violet Cort. Woods. Aug.
220. C. camphoratus. *Fr.* Strong-scented Cort. Ground. Sept.
221. C. callisteus. *Fr.* Stout Cort. Woods. August.
222. C. pholideus. *Fr.* Scaly Cort. Woods. Sept.
223. C. sublanatus. *Fr.* Woolly Cort. Woods. Sept.
224. C. lilacinus. *Peck.* Woods. Sept.
225. C. squamulosus. *Peck.* Scaly Cort. Woods. Aug., Sept.
226. C. asper. *Peck.* Newly cleared places. Sept.

SUB-GEN. Dermocybe. *Fr.*

227. C. anomalus. *Fr.* Thin-capped Cort. Woods. Sept. Oct.
228. C. spilomeus. *Fr.* Scaly-stemmed Cort. Woods. Sept.

SUB-GEN. Telamonia. *Fr.*

229. C. bulbosus. *Fr.* Bulbous Cort. Woods. Aug., Sept.
230. C. lignarius. *Peck.* Decayed wood. June.
231. C. limonius. *Fr.* Lemon Cort. Decaying pine. June.
232. C. hinnuleus. *Fr.* Fawn Cort. Woods. June.
233. C. psammocephalus. *Fr.* Little Tawny Cort. Woods. Aug., Sept.
234. C. illeopodius. *Fr.* Tan-colored Cort. Woods. June, Sept.

SUB-GEN. Hygrocybe. *Fr.*

235. C. Armeniacus. *Fr.* Peach Cort. Woods.
236. C. vernalis. *Peck.* Spring Cort. Ground. June.
237. C. castaneus. *Fr.* Chestnut Cort. Woods. Sept.
238. C. Reedii. *Berk.* Reed's Cort. Shores of lakes. June.
239. C. leucopus. *Fr.* White-stemmed Cort. Woods. May.
240. C. decipiens. *Fr.* Deceptive Cort. Woods. Sept.

GEN. Lepister. *Smith.* Sieem. Jour. 1870.

241. L. nudia. *Bull.* Amethyst Lep. Woods. Prairies. Aug. Sept.
242. L. personata. *Fr.* Purple-stemmed Lep. Ground. Aug. Sept.

GEN. Paxillus. *Fr.*

243. P. involutus. *Fr.* Involute Pax. Ground in woods. Aug. Sept.
244. P. strigosus. *Peck.* Hairy Pax. Ground, woods. Sept.

GEN. Hygrophorus. *Fr.* Terrestrial. Woods, on ground.

245. H. eburenus. *Fr.* Ivory Hygroph. Woods. Sept., Oct.
246. H. cossus. *Fr.* Goat-moth Hygroph. Woods. Sept., Oct.

248. H. aromaticus. *B.* Aromatic Hygroph. Woods. Sept.
249. H. mesotephrus. *B. & Br.* Brown-disk Hygroph. Woods. Aug., Sept.
250. H. hypothejus. *Fr.* Pin-wood Hygroph. Sandy soil. Woods. Sept.
251. H. olivaceo-albus. *Fr.* Olive Hygroph. Woods. Sept.
252. H. leporinus. *Fr.* Hare-colored Hygroph. Terrestrial. Sept.
253. H. pratensis. *Fr.* Pasture Hygroph. Open places, woods. Sept.
254. H. niveus. *Fr* Snow-white Hygroph. Mossy ground. Aug., Oct.
255. H. ceraceus. *Fr.* Wax-like Hygroph. Woods. Sept., Oct.
256. H. miniatus. *Fr.* Vermillion Hygroph. Woods. Aug., Sept.
257. H. coniscus. *Fr.* Conical Hygroph. Terrestrial. Aug., Oct.
258. H. nitidus. *B. & R.* Amongst moss in wet places. Aug., Sept.

GEN. GOMPHIDIUS. *Fr.* Terrestrial mainly.

259. G. viscidus. *Fr.* Viscid Gomphidius. On wood. Aug.

GEN. LACTARIUS. *Fr.* Terrestrial. Mainly in woods.

260. L. torminosus. *Fr.* Woolly Lactarius. Aug., Oct.
261. L. cilicioides. *Fr.* Tomentose Lact. Sept.
262. L. turpis. *Fr.* Dirty Lact. July.
263. L. pubescens. *Schrad.* Pubescent Lact. Aug., Sept.
264. L. zonarius. *Fr.* Zoned Lact. Aug., Oct.
265. L. blennius. *Fr.* Slimy Lact. Aug, Sept.
266. L. pyrogalus. *Fr.* Pear-scented Lact. Aug., Sept.
267. L. plumbeus. *Fr.* Lead-coloured Lact. Aug., Sept.
268. L. chrysorrhæus. *Fr.* Yellow juiced Lact. July, Aug.
269. L. piperatus. *Fr.* Peppery Lact. July, Sept.
270. L. vellereus. *Fr.* Woolly-white Lact. July.
271. L. deliciosus. *Fr.* Delicious Lact. Aug., Oct.
272. L. pallidus. *Fr.* Pallid Lact. Aug., Sept.
273. L. theiogalus. *Fr.* Sulphur-juiced Lact. Aug.
274. L. cyathala. *Fr.* Cup-like Lact. Aug., Sept.
275. L. glyciosmus. *Fr.* Scented Lact. Aug., Oct.
276. L. serifluus. *Fr.* Thin-juiced Lact. Sept.
277. L. fuliginosus. *Fr.* Dingy Lact. July, Oct.
278. L. affinis. *Peck.* Viscid Lact. Sept., Oct.
279. L. volemus. *Fr.* Orange-brown Lact. July, Sept.
280. L. platyphyllus. *Peck.* Aug., Sept.
281. L. sordidus. *Peck.* Sandy soil. Sept.
282. L. griseus. *Peck.* Low ground. Aug.

GEN. Russula. *Fr.* Terrestrial. Usually late Summer and Autumn.

283. R. nigricans. *Fr.* Blackish Rus. July, Aug.
284. R. aduster. *Fr.* Scorched Rus. Sept., Oct.
285. R. delica. *Fr.* Whitish Rus. Woods. Aug.
286. R. furcata. *Fr.* Forked Rus. Woods. Sept.
287. R. sanguinea. *Fr.* Blood-red Rus. Woods. July.
288. R. rosacea. *Fr.* Rosy Rus. Woods. July.
289. R. sardonia. *Fr.* Changeable Rus. Woods. July.
290. R. depallens. *Fr.* Bleached Rus. Woods. July.
291. R. virescens. *Fr.* Greenish Rus. Woods. July, Sept.
292. R. lepida. *Fr.* Scaly Rus. Woods. July, Aug.
293. R. rubra. *Fr.* Red Rus. Woods. July, Aug.
294. R. fœtens. *Fr.* Fœtid Rus. Woods. July, Sept.
295. R. emetica. *Fr.* Emetic Rus. Woods. July, Oct.
296. R. fragilis. *Fr.* Fragile Rus. Woods. July, Aug.
297. R. integra. *Fr.* Entire Rus. Woods. July, Aug.
298. R. decolorans. *Fr.* Discolored Rus. Woods. Sept.
299. R. veternosa. *Fr.* Sleepy Rus.
300. R. nitida. *Fr.* Shining Rus. Woods. Sept.

R. alutacea. *Fr.* Tan-colored Rus. Woods. July, Aug.
R. lutea. *Fr.* Yellow Rus. Woods. August.
R. chamæleontina. *Fr.* Chameleon Rus. Woods. Sept.
R. mariæ. *Peck.* Woods. July, Aug.

GEN. Cantharellus. *Adams' Fung.*

C. cibarius. *Fr.* Edible Chantarelle. Woods. July.
C. aurantiacus. *Fr.* False Chant. Ground and wood. Aug.
C. umbonatus. *P.* Umbonate Chant. Ground. July.
C. tubæformis. *Fr.* Tubæform Chant. Woods. July.
C. infundibuliformis. *Fr.* Funnel-shaped Chant. Ground. July, Aug.
C. minor. *Peck.* Ground in woods. July, Aug.
C. dichotomus. *Peck.* Damp ground. Woods. July, Aug.

GEN. NYCTALIS. *Fr.* Gen. Hymen.

C. asterophora. *Fr.* Star-bearing Nyctalis. Dead Fungi. Sept.

GEN. MARASMIUS. *Fr.* Epiphytal. Terrestrial.

M. oreades. *Fr.* Fairy-ring. Champignon. May, Oct.
M. fusco-purpureus. *Fr.* Purple brown Maras. Woods. June, July.
M. Wynnei. *B. & Br.* Wynne's Maras. Leaves. June, July.
M. erythrophus. *Fr.* Pallid Maras. On ground and wood. July.
M. terginus. *Fr.* Clustered Maras. In woods on wood. June.
M. alliaceus. *Fr.* Onion-scented Maras. Wood. July, Aug.
M. rotula. *Fr.* Collared Maras. Ground. June, Oct.
M. androsaceus. *Fr.* Black stemed Maras. June, Sept.
M. insititius. *Fr.* Horny stemed Maras. Aug., Oct.
M. epiphyllus. *Fr.* Leaf Maras. Woods. June, Oct.
M. saccharinus. *Fr.* Granular Maras. Epiphytal. Woods. June, July.
M. spodoleucus. *B. & Br.* Stemless Maras. Epiphytal. Woods. June, Sept.
M. velutipes. *B. & C.* Woolly Maras. Woods. July.
M. plancus. *Fr.* Hairy Maras. Woods. June, Oct.
M. subvenosus. *Peck.* Leaves in woods. Aug., Oct.
M. campanulatus. *Peck.* Leaves in woods. Aug.
M. cæspitosus. *Peck.* Decaying branches, woods. June.
M. longipes. *Peck.* Among fallen leaves, woods. Aug., Oct.
M. glabellus. *Peck.* Amongst leaves, woods. July, Sept.
M. anomalus. *Peck.* Sticks, leaves in woods. July.

GEN. Lentinus. *Fr.* Generally on wood.

3. L. tigrinus. *Fr.* Tiger-spot Len. June, Oct.
4. L. Dunalii. *Fr.* Dunal's Len. June, Sept.
5. L. lepidius. *Fr.* Scaly Len. June, July.
6. L. cochleatus. *Fr.* Shell Len. June, July.
7. L. vulpinus. *Fr.* Strong-scented Len. May, Aug.

GEN. Panus. *Fr.* Epiphytal. Stumps.

3. P. torulosus. *Fr.* Twisted Pan. Sept.
4. P. conchatus. *Fr.* Shell Pan. May, Oct.
5. P. salicinus. *Peck.* On Salix discolor. Michx. Sept., Oct.
6. P. strigosus. *B & C.* Aug.

GEN. Trogia. *Fr.*

2. T. crispa. *Fr.* Crisped Trogia. On dead branches. Sept.

GEN. Schizophyllum. *Fr.*

343. S. commune. *Fr.* Common Schiz. On dead wood. The season [illegible].

GEN. Lenzites. *Fr.*

344. L. betulina. *Fr.* Birch Lenzites. Stumps. Perennial.
345 L. floccida. *Fr.* Flaccid Lenzites. Stumps. Sept., Oct.

ORDER II. Polyporei.

GEN. Boletus. *Fr.* Terrestrial.

346. B. elegans. *Schum.* Elegant Boletus. Woods. June, Oct.
347. B. flavus. *With.* Bright-yellow Bolet. Woods. July.
348. B. badius. *Fr.* Bay Boletus. Woods. Wright county. Augu[illegible]st
349. B. striæpes. *Sec.* Striate Bolet. Aug.
350. B. chrysenteron. *Fr.* Red-cracked Bolet. Sept.
351. B. subtomentosus. *L.* Yellow-cracked Bolet. Woods. Aug.
352. B. pachypus. *Fr.* Thick-stemmed Bolet. Aug., Sept.
353. B. edulis. *Bull.* Edible Bolet. Woods. Aug.
354. B. æstivalis. *Fr.* Early Bolet. Woods. Esculent.
355. B. purpureus. *Fr.* Purple Bolet. Woods. Aug.
356. B. scaber. *Fr.* Shaggy Bolet. Woods. Aug. Esculent.
357. B. alutarius. *Fr.* Tan-colored Bolet. Woods. Aug.
358. B felleus. *Bull.* Bitter Bolet. Woods. Sept.
359. B. cyanescens. *Bull.* Sibthorp's Bolet. Woods. Aug.

GEN. Polyporus. *Fr.*

360. P. leptocephalus. *Fr.* White-pored Poly. On wood. June, Jul[illegible].
361. P. perennis. *Fr* Perennial Poly. Ground, stumps. Aug., Oct[illegible]
362. P. Rostkovii. *Fr.* Rostkovius' Poly. Rotton wood. June, Se[illegible]t.
363. P. elegans. *Fr.* Elegant Poly. Trunks, branches, woods. Jul[illegible].
364. P. quercinus. *Fr* Oak Poly. Old oaks. June.
365. P. sulfureus. *Fr.* Sulphury Poly. Logs, stumps. June, Sept.
366. P. alligatus. *Fr.* Connected Poly. Base of stumps. June, Sept.
367. P. heteroclitus. *Fr.* Grand Poly. Ground Wright county. Aug.
368. P. salignus. *Fr.* Willow Poly. On Willows. July, Nov.
369. P. chioneus. *Fr.* Soft white Poly. Roots of stumps. Aug.
370. P. cassius. *Fr.* Blue-gray Poly. On pine logs. July, Oct.
371. P. destructus. *Fr.* Destructive Poly. Larch, ground. July, Sept.
372. P. rutilans. *Fr.* Reddish Poly. Branches, woods. June.
373. P. adustus. *Fr.* Scorched Poly. Stumps.
374. P. hispidus. *Fr.* Hispid Poly. Living oaks. Perennial.
375. P. spumeus. *Fr.* Oozing Poly. Trunks, branches. July.
376. P. nigricans. *Fr.* Black-hoof Poly. Living birch. Perennial.
377. P. annosus. *Fr.* Imbricated Poly. Larch stumps. Perennial.
378. P. connatus. *Fr.* Connate Poly. Crab trunks. Miss R. A. Johnson.
379. P. hirsutus. *Fr.* Bristly Poly. Dead trunks. Woods. July.
380. P. versicolor. *Fr.* Common Zoned Poly. Stumps, &c. Persistent.
381. P. abietinus. *Fr.* Whitish Fir Poly. Larch. July.
382. P. contiguus. *Fr.* Contiguous Poly. Decayed wood, &c. June, Sep.
383. P. ferruginosus. *Fr.* Rusty Poly. Posts, &c. June, Sept.
384. P. Armeniacus. *Berk.* Buff Fir Poly. June.
385. P. incarnatus. *Fr.* Flesh-Colored Poly. Larch. July, Aug.
386. P. violaceus. *Fr.* Violet Poly. Poplar Larch. July, Aug.
387. P. medulla-panis. *Fr.* Crumb of Bread Poly. Wood. June, Sept.
388. P. obducens. *Fr.* Incrusting Poly. Rotten wood. Perennial.
389. P. vulgaris. *Fr.* Common-effused Poly. Dead wood.
390. P. vaporarius. *Fr.* Creeping Poly. Fallen branches.
391. P. glomeratus. *Peck.* On Acer saccharinum. *Wang.* Aug.
392. P. Gordoniensis. *B. & Br.* Gordon's Fir Poly. Decaying wood. Sep.

GEN. Trametes. *Fr.*

T. pini. *Fr.* Fir trunk Trametes. Pine trunks. Perennial.
T. odora. *Fr.* Small pored Trametes. Willows.

GEN. Dædalea. *Fr.*

D. unicolor. *Fr.* One-coloured Dædalea. Stumps. Trunks.
D. latissima. *Fr.* Effused Dædalea. On fallen dead branches.

GEN. Merulius. *Fr.*

M. tremellosus. *Schrad.* Tremellose Merulius. Sept.
M. corium *Fr.* Leathery Merulius. Dead trunks.
M. malluscus. *Fr.* Thin Merulius. Dead wood.
M. rufus. *P.* Rufous Merulius. Dead oak branches.
M. serpens. *Fr.* Creeping Merulius. Dead wood. June, Sept.

GEN. Porothelium. *Fr.*

P. Friesii. *Mont.* Fries' Porothelium Pine wood.

ORDER III. Hydnei.

GEN. Hydnum. *Linn.*

H. repandum. *L.* Spreading Hyd. Ground. Aug., Sept.
H. zonatum. *Batsch.* Zoned Hyd. Ground. Woods. Sept.
H. tomentosum. *L.* Tomentose Hyd. Ground. Woods. July.
H. erinaceus. *Hull.* Hedgehog Hyd. Living Oak. Sept., Oct.
H. niveum. *P.* Snowy Hyd. Dead wood. Leaves. Sept.
H. farinaceum. *P.* Mealy Hyd. Decaying wood. July, Sept.

ORDER IV. Auricularini. *Fr.*

GEN. Cratorellus. *Fr.*

C. cornucopioides. *Fr.* Horn-like Cratellus. Ground.

GEN. Thelephora. *Fr.*

T. cæsia. *P.* Ash-gray Thelephora. Incrusting grass.
T. arida. *Fr.* Dry Thelephora. Decaying pine.

GEN. Stereum. *Fr.*

S. purpureum. *Fr.* Purple Stereum. Trunks. Perennial.
S. hirsutum. *Fr.* Hairy Stereum. Stumps. Peren.
S. acerinum. *Fr.* Maple Stereum. Living maple trunks.

GEN. Hymenochæte. *Lev.*

H. rubiginosa. *Lev.* Rubiginous Hymenochæte.

ORDER V. Clavarici.

GEN. Clavaria. *L.*

C. amethystina. *Bull.* Amethyst Clavaria. Sept.

E. glandulosa. *Fr.* Witches'-Butter Exidia. Oak branches. **Aug.**

GEN. Hirneola. *Fr.*

H. Auricula-Judae. *Berk.* Jew's-ear Hirneola. Wood.

GEN. Dacrymyces. *Nees.*

D. stillatus. *Nees.* Orange Dacrymyces. Pine logs.

GEN. Apyrenium. *Fr.*

A. lignatile. *Fr.* Wood loving Apyrenium. Decayed wood.

HYPOGÆI.

FAMILY II Gasteromycetts.

ORDER VII. Hypogæi.

GEN. Hymenogaster. *Tul.*

H. muticus. *B. & Br.* Cracking Hymenogaster. **Sept.**

H. luteus. *Vitt.* Yellow Hymenogaster. Woods. July, Sept.
H. decorus. *Tul.* Comely Hymenogaster. Woods. Aug. Sept.

PHALLOIDEI.

Order VIII. Phalloidei.

Gen. Phallus. *Linn.*

P. impudicus. *Linn.* Common Stink-horn. Sept., Oct.

TRICHOGASTRES.

Order IX. Trichogastres.

Gen. Tulostoma. *Pers.*

T. mammosum. *Fr.* Nippled Tulostoma. Ground.

Gen. Geaster. *Mich.*

G. fornicatus. *Fr.* Vaulting Geaster. Ground. Sept., Oct.
G. striatus. *D. C.* Striate Geaster. On sand.
G. Bryantii. *Berk.* Bryant's Geaster. Sandy soil.
G. hygrometricus. *P.* Hard-coated Geaster. Ground. Woods. Oct.
G. lageniformis. *Vitt.* Flask-like Geaster. Woods. Oct.

Gen. Bovista. *Dill.*

B. nigrescens. *P.* Blackish Bovista. Prairies. May.
B. plumbea. *P.* Lead-colored Bovista. Prairies. Common.
B. ammophila. *Lev.* Rooting Bovista. Woods. Sept.

Gen. Lycoperdon. *Tourn.*

L. giganteum. *Batsch.* Giant Puff-ball. Pastures. Oct.
L. cælatum. *Fr.* Collapsing Puff-ball. Prairies. Aug., Sept.
L. atropurpureum. *Vitt.* Purple-spored Puff-ball. Aug.
L. pusillum. *Fr.* Little Puff-ball. Prairies. June, Sept.
L. saccatum. *Vahl.* Elongated Puff-ball. Thickets. July.
L. gemmatum. *Fr.* Warted Puff-ball. Meadows. Prairies. Aug.
L. pyriforme. *Schæff.* Pear-shaped Puff Ball. Stumps. Sept.

Gen. Scleroderma. *P.*

S. vulgare. *Fr.* Common Scleroderma. Borders of woods. Aug.
S. bovista. *Fr.* Thin-coated Scleroderma. Aug., Sept.
S. verrucosum. *Pers.* Warty Scleroderma. Prairies. Aug.

Gen. Polysaccum. *D. C.*

P. olivaceum. *Fr.* Olive Polysaccum. Ground, woods. Aug.

Order X. Myxogastres.

Gen. Lycogala. *Mich.*

L. epidendrum. *Fr.* Stump Lycogala. July, Oct.

GEN. Reticularia. *Bull.*

474. R. maxima. *Fr.* Large Reticularia. Trunks, fallen trees.
475. R. atra. *Fr.* Black Reticularia. Pine logs. Aug.
476. R. umbrina. *Fr.* Umber Reticularia. Stumps. July.

GEN. Æthalium. *Link.*

477. A. septicum. *Fr.* Æthalium. Woods. Decaying wood.

GEN. Spumaria. *Fr.*

478. S. alba. *D. C.* White Spumaria. Living grass. June.

GEN. Ptychogaster. *Ca.*

479. P. albus. *Corda.* White Ptychogaster. On ground. July.

GEN. Diderma. *P.*

480. D. farinaceum. *Peck.* Invests fern stems in low woods.
481. D. Mariae-Wilsoni. *Clinton.* Sticks, woods. Aug.
482. D. globosum. *Fr.* Globose Diderma. Dead leaves. Sept.

GEN. Didymium. *Schrad.*

483. D. melanopus. *Fr.* Black-stemmed Didymium. Sticks. Aug.
484. D. connatum. *Peck.* Decaying *Russula.* Sept.
485. D. furfuraceum. *Fr.* Scurfy Did. Rotten wood. July, Aug.
486. D. squamulosum. *A. & G.* Scaly Did. Dead leaves, &c. Aug.
487. D. farinaceum. *Fr.* Mealy Did. Dead leaves. Aug.
488. D. pertusum. *Berk.* Pierced Did. Stumps. Oct.

GEN. Physarum. *P.*

489. P. pulcherripes. *Peck.* Rotten wood. July.
490. P. cæspitosum. *Peck.* Rotten wood. Aug.
491. P. atrum. *Fr.* Black Physarum Dead Branches. Aug.

GEN. Angioridium. *Grev.*

492. A. sinuosum. *Grev.* Twisted Angioridium. Sept.

GEN. Craterium. *Trent.*

493. C. mutabile. *Fr.* Changeable Craterium. Bark. July.

GEN. Diachæa. *Fr.*

494. D. elegans. *Fr.* Elegant Diachæa. Dead leaves. Aug.

GEN. Stemonitis. *Gled.*

495. S. fusca. *Rath.* Brown Stemonitis. Dead wood. June.
496. S. ferruginea. *Ehrb.* Rusty Stemonitis. Dead wood. July.
497. S. ovata. *P.* Ovate Stemonitis. Rotten wood. June.
498. S. obtusata. *Fr.* Obtuse Stemonitis. Rotten wood. June.

GEN. Arcyria. *Hill.*

499. A. nutans. *Fr.* Nodding Arcyria. Rotten wood. June.

ORDER XI. Nidulariacei. *Tul.*

GEN. Polyangium. *Link.*

500. P. vitellinum *Ditm.* Egg-yellow Polyangium. Stumps.

FAMILY III. Coniomycetes.

ORDER XII. Sphaeronemei.

GEN Phoma. *Fr.*

501. P. ampelinum. *B. & C.* Dead grape vines. Woods. July.
502. P. exiguum. *Desm.* Little Phoma. Elder shoots. Aug.
503. P. glandicola. *Lev.* Acorn Phoma. Acorns. Sept.

GEN. Discella. *B. & Br.*

504. D. carbonacea. *B. & Br.* Black Discella. Dead twigs.

ORDER XV. Pucciniæi.

GEN. Phragmidium. *Link.*

505. P. mucronatum. *Link.* Rose Brand. Living Rose leaves. Aut.
506. P. gracile. *Greve.* Raspberry Brand. Rasp. leaves. Aut.
507. P. obtusum. *Link.* Strawberry Brand.
508. P. graminis. *Pers.* Corn mildew. Leaves of corn. Aut.
509. P. striola. *Link.* Sedge Mildew. Rushes. Autumn.
510. P. coronata. *Corda.* Coronated Mildew. Grasses.
511. P. vaginalium. *Link.* Knot-grass Brand Aut.
512. P. primulae. *Grev.* Primrose Brand. Primroses. June.
513. P. variabilis. *Grev.* Variable Brand. Taraxacum. July.

GEN. Gymnosporangium. *D. C.*

514. G. juniperi. *Lk.* Living branches.

ORDER XVI. Cæomacei.

GEN. Tilletia. *Tul.*

515. T. caries. *Tul.* Bunt. On wheat filling the grains. Aut.

GEN. Ustilago. *Link.*

516. U. carbo. *Tul.* Corn smut. Autumn.
517. U. antherarum. *Fr.* Anther Smut. Lychens, &c.
518. U. violae. *B. & Br.* Violet Smut. Violet leaves. August.
519. U. occulta. *Preus.* Rye smut. On culms of rye.

GEN. Uredo. *Lev.*

520. U. Quercus. *Brand.* Oak-leaf Uredo. Sept.
521. U. bifrons. *Grev.* Twin-faced Uredo. On *Rumex.* Aug., Sept.

ORDER XVII. Æcidiacei.

GEN. Æcidium. *Pers.*

522. A. euphorbiæ. *Pers.* Spurge Cluster-Cups. May, June.
523. A. urticæ. *D. C.* Nettle Cluster-Cups. June.

FAMILY IV. Hyphomycetes.

ORDER XVIII. Isariacei.

GEN. Isaria. *Fr.*

524. I. arachnophila. *Ditm.* Spider Isaria. Dead spiders.
525. I. citrina. *P.* Lemon-colored Isaria. Decaying fungi. Aug.
526. I. intricata. *Fr.* Intricate Isaria. Decaying fungi. Sept.

ORDER XIX. Stilbacei.

GEN. Tubercularia. *Tode.*

527. T. granulata. *P.* Granulate Tubercularia. Dead branches.

DIVISION II. Sporidiifera.

FAMILY VI. Physomycetes.

ORDER XXIV. Mucorini.

GEN. Ascophora. *Tode.*

528. A. elegans. *Corda.* Elegant Ascophora. Fowls' dung.

GEN. Mucor. *Mich.*

529. M. ramosus. *Bull.* Branched Mucor. Decaying fungi. Aug.
530. M. Mucedo. *L.* Common Mucor. Decaying fruits.
531. M. caninus. *P.* Dog's dung Mucor. Dung of dogs.

FAMILY VII. Ascomycetes.

ORDER XXVIII. Elvellacei.

GEN. Morchella. *Diel.*

532. M. esculenta. *Pers.* Common Morel. Woods. May, June.

GEN. Helvella. *Linn.*

533. H. gigas. *Kromb.* Large Helvella. Ground, woods. Spring.
534. H. crispa. *Fr.* Pallid Helvella. Ground, woods. Early Summer.
535. H. sulcata. *Afz.* Sulcate Helvella. Ground, woods. Oct.

GEN. Verpa. *Swartz.*

536. V. digitaliformis. *Pers.* Finger-shaped Verpa. Wood.

GEN. Spathularia. *P.*

587. S. flavida. *Prs.* Yellow Spathularia. Woods. July.

GEN. Leotia. *Hill.*

588. L. lubrica. *Pers.* Slimy Leotia. Woods. Sept.

GEN. Geoglossum. *P.*

589. G. viride. *P.* Green Geoglossum. Decayed wood.
590. G. glutinosum. *P.* Glutinous Geoglossum. Woods.

GEN. Peziza. *Linn.*

541. P. macropus. *Pers* Long-stemmed Peziza. Ground. July.
542. P. badia. *P.* Large Brown Peziza. Pond margin. July.
543. P. aurantia. *Fr.* Orange Ground Peziza. June.
544. P. lutea-nitens. *B. & Br.* Bright Yellow Peziza. Ground.
545. P. fibrillosa. *Curr.* Woolly Orange Peziza. Oct.
546. P. repanda. *Wahl.* Spreading Peziza. Gound. June.
547. P. trachycarpa. *Curr.* Rough-spored Peziza. Woods.
548. P. leiocarpa. *Curr.* Smooth-spored Peziza. Ground.
549. P. cupularis. *L.* Scolloped Peziza. June.
550. P. subhirsuta. *Schum.* Hirsute Peziza. Ground.
551. P. humosa. *Fr.* Ground Peziza. Woods.
552. P. scutellata. *L.* Shield-like Peziza. Woods. May, Sept.
553. P. unicisa. *Peck.* Ground in woods. Sept., Oct.
554. P. echinosperma. *Peck.* Ground in woods. June.
555. P. rubra. *Peck.* Burnt ground. June.
556. P. tiliae. *Peck.* Dead branches. Tilia Americana. July.
557. P. coccinea. *Jacq.* Carmine Peziza. Wood. Nov.

ORDER XXXI. Sphæriacei.

GEN. Valsa. *Fr.*

558. V. pulchella. *Fr.* Beautiful Valsella. Cherry and birch.

With three or four exceptions, the plants constituting the foregoing list of *Fungi*, have been found by the writer.

Respectfully contributed,

A. E. JOHNSON.

MINNEAPOLIS, January 1st, 1877.

VI.

ORNITHOLOGY.

REPORT OF DR. P. L. HATCH.

Prof. N. H. Winchell:

In accepting the position of Ornithologist on the Geological and Natural History Survey of the state to which I have been appointed by the Board of Regents, I desire to express to you and the Board my appreciation of the honor thus conferred upon me.

When first proposed to me to undertake this work, its objects were so accordant with my inclinations that I had only to harmonize its requirements with the exacting duties of my profession, to enter enthusiastically upon it. This our mutual arrangements have enabled me to do more satisfactorily than I had hoped. I therefore permit myself to expect to have something to report to you at the end of another year appropriate to an embodiment in the permanent records of your comprehensive work.

To do this I must be permitted to rely upon the co-operation of not only yourself and the other members of your staff, but of the Board, and all collectors temporarily or permanently associated with the survey.

I have had sufficient experience in the work before me to realize the necessity of aid from reliable sources, and this department of your survey has been so long delayed that it must be rigorously prosecuted if it shall keep its place alongside of the others in the years to come. I do not commence it, however, entirely *de novo*, having had some nineteen years observations in which I have accumulated some notes on birds in my vicinity, with occasional explorations into other sections as fully represented by them. The rapid settlement of the state has changed the relative representation of this class of its fauna very materially, and the increasing extent of the cultivation of the soil for varied productions is at present not only changing the aggregate numbers of birds that come here to breed, and those that permanently reside here, but the relative proportions of species, which shows the importance of early attention to this department of the zoology of the state.

The earliest information on this subject that I have been able to

get has been obtained through interviews with persons connected with the army or trappers and traders, stationed at the several military posts at a very early day. Of course this has been meagre, and unsatisfactory because, to a large extent, it has been unreliable. After sifting it as carefully as possible I find about fifty to sixty species that are known to be territorial and aboriginal.

The first approximation towards a listing of species was made by Henry Patton in connection with Owen's geological survey of Wisconsin, Iowa and Minnesota, in 1848–9. As he did not record the locality, or any of the circumstances of his observations, his list I regret to say is but little more valuable than the foregoing, as it is impossible to ascertain what portion of the ninety-five species he gives were obtained within our own special province. It is not a little remarkable that in the several explorations by the national government preliminary to the location of our great transcontinental railroad, made upwards of twenty years ago, while ample provisions were made for collecting the birds along the various lines of exploration in every other instance, that from St. Paul to the Rocky Mountains had none. From thence to the Pacific the collections were as abundant and the reports as full as on any other route embraced in these extensive explorations. But in subsequent railroad surveys—in 1870, I think,—along the line of the Northern Pacific, Mr. Tripp reported a list of 138 species observed, which only recently came to my notice in the Proceedings of the Essex Institute of Massachusetts. Excepting the few mentioned, my own notes of observation, published by the Minnesota Academy of Natural Sciences in 1874, had antedated them so far as this section was involved.

There have been occasional observations noted by persons visiting or passing through the state, which have been preserved, that are reliable.

During the last year—1876—several species hitherto unknown here have been identified, making at the present time a list of about two hundred and seventy-five species, embracing one hundred and sixty-one genera, in thirty-eight families under six orders.

This comprises nearly the entire history of the ornithology of Minnesota, up to the present time, so far as my knowledge extends.

Very respectfully yours,

P. L. HATCH.

Minneapolis, Jan. 10, 1877.

VII.

ENTOMOLOGY.

REPORT OF ALLEN WHITMAN.

SAINT PAUL, MINNESOTA,
December 23d, 1876.

Prof. N. H. Winchell, State Geologist:

SIR:—I have the honor to present the following report upon the Rocky Mountain Locust,* as it has appeared in and near Minnesota during the year 1876. At the time of my appointment (in May) to make this report, through the State Geological Survey, there was a hope, and apparently a reasonable one, that the coming summer would close our present opportunities for observing the destructive species of locust, at least as far as our state was concerned. The insects were found to be hatching in a region covering the whole or parts of five or six of our southwestern counties, in a strip of country reaching from Madelia westward across the state, and into two of the eastern counties of Dakota. A few were also found in the northern part of the state in Clay county, and in a few scattered spots in Dakota along the Red river. No other hatching-ground nearer than Colorado was known, and there was reason to believe that the amount of damage resulting from their presence here would be comparatively small, and

* The name "Rocky Mountain Locust" is expressed or implied throughout this report. I suppose that every one knows that it is the *Caloptenus Spretus*, or the "grasshopper," that is referred to. Although the name "hopper" holds its place in popular usage, by force of its brevity and euphony, the use of the word locust can occasion no ambiguity, at least in Minnesota. In regard to the latter name, an old etymology is still often repeated, which has done duty long enough. The word *locust* (Latin, *locusta*,) is not derived from the Latin *locus-ustus*, a *burnt place*, and that for half a dozen reasons. The root of the word (*loc*) is probably found in the Greek root *lak* (in *lasko*, *e-lak-on*,) and in the Latin *loqu-or*, referring in this case to the chirping or shrilling sound of some insect called *locusta*. Its form is confirmed by such Latin words as *robustus*, *venustus*, &c. See *Fick, Vergleichendes Woerterbuch der Indogermanischen Sprachen. Part IV. Root* (3.)

fair probability that their swarms would be so scattered and so diminished during the summer, that the injury would, for the present, end with the flying season. Under these circumstances, it seemed best to make such additions and corrections to the Report of the Grasshopper Commission of 1875, as the experience of the present year should furnish. But as the season has advanced, and events have multiplied themselves, the subject has assumed, both in extent and urgency, a new and continued importance. Following close upon the attack of 1874, we have a new locust invasion, surpassing all former ones in the amount of territory visited, in the magnitude of the invading swarms, in their repeated comings, and in the length of their combined stay. In addition to the losses inflicted upon the crops during the last four summers, amounting to at least eight millions of dollars, we find the evil still confronting us as in 1873, and while we have gained something by our four years' experience, we have also lost something by the disheartenment which four successive years of damage necessarily bring. To meet in any such report as this the demands of a subject so extensive and important, or the expectations of the large number of people who are so deeply interested in it would be simply an impossibility, but I should be glad if anything contained in it could add to the knowledge necessary for intelligent action, or to the hopefulness which we may reasonably entertain in regard to the locust problem in the long run. Such as it is, the report is the result of several visits to the southwestern counties during the spring and summer, of replies to circulars sent to nearly every interested town in the state, and of a large amount of correspondence addressed freely to various points in Minnesota, Dakota, and elsewhere. To compile such information as could be collected from all these, and from hundreds of items published in our state papers during the summer, has been a work of a good deal of time and trouble. The practical value of the results of work of this kind seldom corresponds to the amount of trouble incurred, but this is simply the fault of the subject.

GENERAL VIEW OF LOCUST INVASIONS.

Taking into consideration the whole cultivated region from Manitoba to Texas and from the Rocky Mountains to the Mississippi, there have been in the series of thirteen years from 1864 to 1876, but four, (or at most five) years when some portion of this area was not attacked by locusts, coming in from somewhere outside of the cultivated area. In other words there have been no less than nine locust invasions, (differing much in extent and degree, but still occurring,) in the Mississippi and Red River valleys during the last thirteen years. And these nine attacks stand against some seven or eight recorded appearances of destructive locusts in the same territory during the 46 years preceding, from 1818 to 1864. Again we have on the one hand the sudden appearance of the immense swarms which are said to have overrun a vast extent of territory on both sides of the Rocky Mountains in

the next three years, apparently without furnishing material for subsequent invasions, and their continued absence for the next six years. On the other hand we have, since 1864, a series of attacks occurring at intervals of one, two, or at most three years, and apparently of late an annual vibration between the country lying along the mountains and the lower cultivated regions, each in its turn becoming a breeding-ground. The causes of the increase and continuance of the evil of late years lie outside the range of common observation. That they do not result entirely from an increase of acreage under cultivation, is to be inferred from the locust history of other countries, and from the facts that while Central America has suffered from the same evil at least as far back as 1514 (Bancroft's Native Races of the Pacific Coast, vol. v., page 601,) and Mexico and California at least as lately as 1855, the exemption of these countries since the latter date has been as noticeable as the repeated devastation of our own vicinity. As for any analogy to be derived from the locust history of European countries the books are not at hand in this state to furnish the exact chronology of the evil; but from such a source as I have at hand, the record of Germany for the last four centuries shows intervals of exemption from injury for eight, twelve, sixteen, forty (1763—1803,) or even fifty (1636—1686) years, and again no less than fourteen years of injury between 1727 and 1755, and among these series of three, four, or even five successive years of damage, as in the five years from 1727 to 1731, and again from 1746 to 1750.*

The locust problem still presents a great deal upon which nothing like complete information has been furnished. Even in regard to the locust as it appears in our own State, not only does the farmer ask many questions, to which the entomologist can as yet give no decisive answer, but even in the practical economy of the locust question opinions are still at variance, where experience should, by this time, have brought some degree of unanimity. When it comes to the exact origin of our invading swarms, their manner of increase from year to year before leaving their native regions, their growth, habits, and movements in those regions, how far eastward those regions may or do extend, the causes of the repeated appearance of migrating swarms, or their continued absence for years or even decades, no one can at present offer in answer much more than a mere show of probabilities. It is evident that the whole question is becoming too urgent to wait for private investigation to solve it. The claims which an agricultural population of at least thirteen States and Territories may justly urge

* These dates are taken from a work entitled, Die Kleinen Feinde der Landwirthschaft, by Prof. H. Nordlinger, Stuttgard, 1855, furnished by the kindness of Gustav Kyllander, Esq., of Severance, Sibley county. For a systematic and connected view of the locust evil in general see a paper contained in the Report (for 1876) of the Hon. Commissioner of Statistics of Minnesota, Dr. J. B. Phillips. Notice is particularly called to a chronological table published therein. It will be seen that there is no state or territory west of the Mississippi that is not in the "grasshopper regions," and no year since 1863 that has not been a locust year. The year 1871 should be included in the table, for reasons stated in this report.

upon the National Government in this regard, have been fully s
forth during the past season ; but purely in the interest of scienc
if for no other reason, we might fairly ask that some portion
the sums annually devoted to national discovery might be expend
upon the further elucidation of a subject which touches us
nearly and so powerfully. Having at hand the time, the plac
and the opportunity, we might at least attempt the solution of son
questions which the Old World has been obliged to leave una
swered for a thousand years. We might, perhaps, learn enou
of the causes of locust invasions to know in what years such i
vasions would become probable, and enough of their origin to s
whether prevention is possible or impossible.

THE EVIL AS IT APPEARS IN MINNESOTA.

The growth and habits of the young locust as it appears in t
cultivated regions, have been so fully described of late yea
(particularly in the seventh and eighth annual reports of the Sta
Entomologist of Missouri, Prof. Ch. V. Riley,) that it seems ir
possible to add much that can contribute to that practical e
which the farmer has in view, the protection of his crops fro
the locusts which hatch in his immediate vicinity. If anythi
practical is still to be expected in this direction it ought to co
from those who are brought face to face with the young locus
and are obliged to act upon knowledge gained upon the spo
Enough has been learned already to make it certain that almo
any community may, by enlisting all the forces at its disposa
effect a measurable saving of its crops, and that the evil, if
could be confined to the locusts that hatch here, might be pra
tically eradicated in a few years at most. But there is a growi
apprehension in the minds of the people of Minnesota, brougl
about mostly by a consideration of events occurring in our ow
state only, and that too only within the last four years, that
are more liable to locust invasions than other states; that t
locust evil may become a permanent one here even without rei
forcements from abroad, and that its area may gradually exte
until it covers regions still unknown to it. This apprehension
increased by the fact that the invasion of the present year h
reached, (to the south of St. Paul,) about one degree of longitu
farther east than it has ever been known to extend before. It
possible that Minnesota may, from its geographical positio
suffer from locust invasions more frequently in the long run
fifty or a hundred years than Kansas or Manitoba, though
history of the last twenty years shows no special preponderan
in favor of either state; it is possible that its cold climate, a
the high and dry soil of its southwestern counties may furnish
more congenial and permanent home to the swarms that bre
ere, though the events of the last four years, when fairly co
idered, show that even here there is a constant decrease in t
umbers of such swarms as remain; and finally the history of t
hole Mississippi Valley shows that the Rocky Mountain Locu
confined on the east by a tolerably well defined limit which

to the present time, neither invading swarms, nor their progeny have essentially altered. Upon all these points entomologists are repeatedly called to express their opinions, which have been freely and in most cases cautiously given; and these opinions are in turn repeatedly called into question by those who persist in mistaking opinion for prophecy, or in applying a general rule to a limited area, or to a particular year. But it is evident that there is still room for the study of the physical character of the locust, and of the geographical, geological, climatic or other causes by which it is influenced.

HISTORY OF PAST INVASIONS.

Until within the last four years the migratory species of locusts has been so infrequent and transient a visitor in Minnesota, that the details of its former visits are almost forgotten. There is no definite knowledge of any such visit down to the year 1855, unless the ravages committed in the Red River Settlement in 1818 and 1819 may be said to concern this State. But the statement of Capt. Jonathan Carver in 1766, in regard to the large swarms which "infest these parts and the interior colonies" shows the occasional presence of the migratory locust, although it is hard to say exactly what localities are referred to. But late in July, 1856, invading swarms came from the Northwest into the Upper Mississippi Valley, and gradually spread along the river during the season, much the same as they have done in the past summer, and reaching nearly the same limits. The injury was, of course, felt most severely along the Mississippi and the cultivated region adjacent, but the locusts are said to have appeared along the Minnesota River, in the Yellow Medicine country, and at various points in the northwestern counties of the State. It is probable that the northwestern part of the State was swept over by migrating swarms during the summer, much the same as in the present year. But few traces of these were seen in the following year, except along the Upper Mississippi, where the damage was even greater than the year before. A general flight took place in July, and the direction of the departure was to the south and southwest generally, and was, perhaps, the occasion of the injury done in Iowa that year.

Again, in 1864, swarms appeared early in July, along the Upper Minnesota river, and spread eastward gradually during the season, and reached about as far east as in 1874, *i. e.*, to the third tier of towns in Le Sueur county. Scattering swarms also visited Manitoba in the same year, and probably some portions of these reached Northwestern Minnesota, for we hear of slight appearances of them in the Red River and the Sauk Valleys in 1864 and 1865. But the greater portion of the injury was done in the Minnesota Valley, and was followed by a general departure to the southwest in 1865. The injury in Colorado also was very severe in the same years, but there seems to have been no large movement to the eastward, such as occurred later, in 1866 and 1867.

It seems very likely that the swarms which entered Minnesota

n 1864 were hatched at no great distance, and were the offspring of swarms that had alighted in eastern Dakota in the preceding ear. This may perhaps be inferred from the following letter of he Rev. S. R. Riggs, missionary at the Sisseton Indian Agency, lated Sept. 9, 1875:

"In 1863, it will be remembered, that on Gen. Sibley's expedition to the Missouri we met with the *ravages* of the grasshoppers in various parts of Dakota, particularly, as I remember, near Skunk Lake (in Minnehaha county) where the large grass had been eaten to the bare stalks, and our animals ared badly" He adds:

"In 1865, I visited a camp of Dakota scouts, near the 'Hole in the Mountain,' at the head of the Redwood. That was in the month of August. The valley of the Minnesota clear out to the Coteau was so full of grasshoppers as to make it unpleasant traveling. For the next four years, traveled every summer on the Missouri River, coming over to and from Minnesota. Every season I met with grasshoppers at some point on the ast side of the Missouri. In 1867, and also in 1868, we found them near Fort Randall. In 1869, in August, we met them above Fort Sully, near Grand River. In all these cases, they were only in small battalions, and ppeared to have come there from other parts."

Again, in 1871, slight and scattering swarms of locusts appeared n Stearns, Todd, Douglas, Pope, Otter Tail, Becker and Polk ounties, and perhaps in others. In all these counties they were in sufficient numbers to make themselves noticeable, and in some ases crops were injured, or a few eggs laid; but the occurrence would have been mostly forgotten by this time if it had not been brought to mind by more recent events.

The invasion of 1873 was something unusual in its character from the earliness of its arrival, the direction from which it came, and from the fact that it was the beginning of a visitation which has been prolonged to the present time by what, judging from former years, would appear to be unusual circumstances. Each summer since 1873, instead of being the scene of a general departure of the hatching swarms as in former years, has seen portions of these alighting but a few miles from where they were hatched, (generally in the next range of counties, and sometimes in other parts of the same county,) and depositing eggs for another brood. In addition to these, new swarms coming in from the northwest in 1874 and again in 1876, have added greatly in the area of devastation in both these years, and in the latter year to the area of egg-deposit.

MINNESOTA AS A BREEDING GROUND OF THE LOCUST.

Without saying anything for the present about the new coming swarms, the history of those that have bred inside the State since 1873 has been as follows: They reached the southwestern corner of the state about the first of June, 1873, brought by a wind that had been blowing freshly from the southwest for several days. During June and July, they spread themselves over the whole or portions of fourteen different counties, lying adjacent to each other, and throughout all this area locusts were found to be hatching in 1874. On acquiring wings, these flew northward early in

July, and portions of them alighted in the range of counties next beyond those they had already occupied, leaving vacant the ground they had covered on hatching. By the 15th of July they had entered Blue Earth, Nicollet, McLeod and Renville counties. By the latter date, new swarms had begun to pour in from the northwest, and passed over the western counties to the southward. That these additional swarms did not add much to the stock of eggs deposited by our own brood is probable, for two or three reasons: first, because their progress, so far as it could be traced, was entirely across the state, and even across most of western Iowa, before laying eggs; and secondly, because the principal hatching-ground of 1875 was precisely in those counties which had been already occupied by our own stock in 1874 (before the arrival of new comers) with some slight additions to the eastward. Eggs were also laid, later in the season, in scattered spots in some of the northern counties, and in six towns in Meeker county, by swarms coming in from the northwest about the first of August. But the greater portion of the locusts hatched in 1875 were found along the Minnesota River, and these on flying moved southward, and alighted in the range of counties next beyond those they had just occupied, where they remained and deposited eggs during July and August. Of the swarms hatched from these last spring (1876) some flew away to the southward early in July, while others flew northward, some alighting along the Minnesota, and others moving still further north. Other swarms also came from the west, from the Red River valley, into several of the northern counties, and were probably a portion of those that hatched along the Red River. By the 10th of July all these had made their appearance in thirteen counties besides those in which they were hatched, but generally in small and scattered bodies, and in only two or three towns in a county; they were most numerous in Renville, Douglas, and Otter Tail counties.

The object of the preceding paragraph is to show that it is probable that the locusts which hatched in Minnesota last Spring were to a considerable extent the descendants of the swarms which entered the State in 1873. However unimportant it may seem, it has a certain value if it enables us to judge of the effect upon the Rocky Mountain locust resulting from a four years' continuous breeding in our climate.

DEGENERATION.

So much has been said of late years of the tendency of the migratory locust to "degenerate" in the more easterly and southerly portion of the area visited by it, and this theory has been considered by our people so complete a failure, that it is worth while to state exactly what the theory is, and how truly it applies to our State. It might have been submitted at the start that opinions based upon a consideration of events still occurring, and more or less liable to be modified by new circumstances, should not be pressed too far nor too literally; and it was just that in judging as to the correctness of these opinions, that they should

ave been fairly stated. I give them in the briefest form in which find them: "There is nothing more certain than that the sect is not autochthonous in West Missouri, Kansas, Neraska, Iowa, or even Minnesota, and that when forced to migrate om its native home, from the causes already mentioned, it no nger thrives in this country." (Riley's Seventh Annual Report, 165.) It will be noticed that Dakota and Colorado are not cluded in this list; that Minnesota is to some extent excepted, nd that, though not directly stated in the sentence quoted, the pplication is to swarms breeding one year after another in the egions mentioned, and not to such fierce hordes as have swept own upon us from the northwest in the summers of 1874 and 876. The discouraging events of the last four years have served o confuse the question, and it is no wonder that our farmers, eeing the considerable numbers that have remained to breed here rom one year to another, with the intolerable numbers that have een added in two out of four seasons, should come to believe hat Providence has given over one half of our state to be henceorth the perpetual home of the locust. We have a series of ccurrences so different from those of Missouri, Kansas and Neraska, that it seems hard to account for them on any basis of ere accident or of which way the wind happens to blow when ur swarms are ready to migrate.

The winds which sweep clean away the hatching swarms of the nore southern states carry our own but a few miles from their irth place. It is evident that they are not detained here merely y abundance of food, for the swarms of Kansas and Missouri eave behind them fields as rich as ours; nor by force of winds, for he same winds that bring down upon us invaders born hundreds f miles away, and carry them across our state and into more outherly regions, might also carry with them the broods of our wn hatching. I believe it is not as yet fully known what conection there may be between the migrations of the locust and its eason of egg-laying, but it seems that some cause for the fact hat portions of our swarms remain here to breed can be found n an early stage of egg-laying. Here again we have a difference etween our own broods, and not only the new swarms that come in pon us from the mountain regions, but also those which leave the ore southerly regions and fly to the northwest on acquiring ings. As for the latter, in the flight from the Missouri Valley orthward in 1875, Prof. Riley was able to learn of no case of heir depositing eggs, nor were the hatching grounds, (outside of linnesota,) of last spring found to be anywhere in the vicinity f those of 1875; as for the swarms that have descended upon us luring the summer, I have not been able to learn of any deposit f eggs whatever in any of their stopping places on their way toward this state, and even on arriving here it was evident in most cases that they had not yet reached the season of egg-laying. Between the 17th and the 31st of July there was a gradual movement, apparently of new-comers, across the state towards Iowa, and the egg-laying did not become general until about the latter date. Between the first and sixth of August other swarms came

in, and these again in most cases did not begin to lay until a week or more after their arrival. Still others came in later, and the laying was kept up until late in September and was seen to occur in October, or as long as the locust remained alive. On the other hand our own stock were seen in 1875 to be laying within eight days after their flight commenced and in the places where they first alighted, and during the past season the laying had already begun on the third of July and by the tenth had become general in the western part of Nicollet county, within a few miles from their hatching-ground, and within two weeks from the time when the flying began. This early period of laying may be of itself a sufficient cause for portions of our swarms remaining here, while the less mature pass on.

NATURAL DECREASE FROM ONE YEAR TO ANOTHER.

But though portions remain, there is no increase in their numbers from one year to another. So far from holding its own, the locust has seen its breeding grounds decrease from nearly fourteen counties in 1873, to some seven and a half counties in 1874, and about five and a half counties in 1875; and in this latter area though able to inflict serious damage in many places (owing chiefly to the small acreage planted) they were in other places noticeably fewer than in former years.

This continuous decrease has resulted from several causes, and the first of these is the early stage of laying just alluded to, by means of which considerable numbers of locusts have hatched out during the last two autumns, and have died without reproducing themselves. In this connection, the state of Minnesota has an advantage over more southerly regions, in the fact that we are situated nearer to the breeding-grounds of invading swarms. Of these the earlier comers are more likely to pass over us before reaching the full period of their development, while the later comers are cut off by our earlier frosts; and of the eggs which are left with us, being deposited earlier in the season, more are likely to hatch in the fall and become harmless. On the other hand, the invaders are more likely to mass their forces in more southerly states, reach them in full maturity, and remain later in the season, while the eggs, being deposited later than ours, remain mostly unhatched until spring. These considerations enable us to understand why certain counties in Missouri, where the locusts hatched in 1875, presented in May such a picture of devastation and desolation as Minnesota has never seen in all its locust experience.

But while becoming prematurely developed, (if this is a correct expression of the facts as stated,) the locust had also become shorter lived. One year ago, there was hardly such a thing as a Rocky Mountain locust to be found in Minnesota by the first of September. The swarms that had hatched along the Minnesota River in the spring, and had alighted but a few miles further to the south in July, had almost totally perished in August, without extending the territory of their occupation more than the width of one county beyond the area which they covered on alighting. And

n this connection we owe more to the Tachina maggot than many ıre willing to allow. But of the invading swarms of the present ear, though large numbers of the bodies of the dead could be ound in the fields early in September, (something unusual, from he fact that heretofore they have hardly ever been found at all,) arge numbers remained alive until they were killed by frost, and ven then died with eggs unlaid.

Still another effect of naturalization during the last four years s an apparent change in character, slight in itself, but showing vhat the tendency would be if the locust were to continue to breed ıere. While it has lost some portion of its inclination or its ability o migrate, it has also lost somewhat of its gregarious character. This was shown by the young locusts last spring, moving over the ields in scattered bodies, or in no bodies at all, a peculiarity so ıoticeable as to attract the attention of the farmers; by the move- ments of the swarms on leaving their hatching-grounds, in small quads and in various directions; and by the fact that where they lighted first they left their eggs promiscuously here and there in he grain fields, instead of in bodies and in selected spots as here- ofore. There was no general flying from their hatching-ground n large bodies, mostly in one direction, as was the case in 1874 nd 1875. By the last week in June they began to leave some laces so imperceptibly that their departure could hardly be seen, ıough their numbers were noticeably diminished. For the first n days of July, small squads went careering up and down, south f the Minnesota river, and wherever there was anything like a ıovement of large bodies they seem to have left the state to the orthwest, west, and southwest. In the meantime, others had pread themselves northward towards the North Pacific Railroad, nd had alighted here and there in numbers sufficient to do con- iderable damage. But, judging from the occurrences up to the 0th of July, had it not been for new-comers, next year would ave seen the insects so few and so scattered as to be incapable of reat damage, and they might become, in a year or two, as flitting nd as unnoticeable as the Red-Legged Locust that breeds with us very year.

Probably this is all that can be made of the "degeneration" of ıe locust so far as observed in Minnesota. It had not become so ıpaired in strength nor so diminished in numbers as not to prove serious evil wherever it alighted or laid eggs. It was however ecreasing in numbers, and gradually becoming less capable of producing itself. Something might perhaps be added in regard changes in color and appearance; while the locusts which hatched Minnesota last spring had when fully developed something of ıe darkness and dullness of old age, the brightness and fierce- ess of the fresh invaders was apparent to every one.

The facts stated show the general tendency, but there is a more ital question than the tendency of the locust to degenerate here. low long the state will continue to be one of the breeding- rounds of the locust, is simply how long new hordes will continue o sweep over us and leave here fresh seeds of future devastation.

continued effort, practically eradicate the offspring of almost any one year's invasion; nothing is more probable than that in almost any season, the whole body of our hatching swarms might be utterly swept away from our midst by favorable winds; and finally, if we may judge from the last four years, our breeding-swarms would decrease gradually from one year to another, and if not reinforced from abroad would finally become so few and so scattered as to be harmless.

ANNUAL DEPARTURE OF THE LOCUSTS.

Besides the causes of decrease already mentioned, still another has been found in the impulse which moves the locust to leave its birthplace on acquiring wings. The considerable numbers that have remained behind each year, have created the impression that none were gone, and that the locust had become a permanent appendage of the state. But a collection of various items for the last three years, together with letters received from the eastern tier of counties in Dakota, shows that considerable numbers have left the state, generally to the northwest in 1874, and in various directions during the past summer. But, with Dogberry, we have been content to "take no note of him, but let him go, and thank God we were rid of a knave." It is only within the last year or two that it has become fully apparent that the final destination of these departing swarms is an important consideration, and one which serves to complicate the locust question more deeply than ever.

Whether or not it is a general rule that the locusts on acquiring wings seek the direction from which their parents had come in the preceding year, (a rule which the experience of Minnesota fails to substantiate,) it is at least certain that in 1875 "the main direction taken by the insects that rose from the lower Missouri valley country was northwesterly." (Riley's 8th Ann. Report, p. 105.) These swarms were traced by Prof. Riley, moving northerly from the end of May, through June and into July, and passing various points in Dakota, Wyoming and Montana.*

They passed northward over Bismarck at various times between June 6th and July 15th. (Same report, p, 86.) But a still more definite statement as to the final destination of these northward moving swarms is found in an editorial of the Winnipeg *Standard*, of August 19, 1876, entitled "Locust Flights." It is there stated that in 1875,

"The locusts which hatched in Missouri, Kansas and Nebraska, in an area of 250 miles from east to west, and 300 miles from north to south, took flight in June, and invariably went northwest, and fell in innumerable swarms

* He adds (page 108) "nor can I learn of any instance where these swarms that left our territory deposited eggs." The different case of our own breed of locusts, laying eggs within two weeks after the flying commences, is remarkable. But I am informed by Captain J. S. Poland, commanding at Standing Rock, that a swarm from the south alighted near that post, July 4th, 1875, and deposited considerable quantities of eggs between the 4th and the 18th of July.

n the regions of British America, adjoining Forts Pelly, Carlton and El-
, covering an area as large as that they vacated on the Missouri River.
ey were reinforced by the retiring column from Manitoba, and it seemed
e hoping against hope that the new swarms of 1876 would not again de-
d upon the settlements in the Red River valley. Intelligence was re-
ed here that the insects took flight from the vicinity of Fort Pelly on
10th of July, and then followed a fortnight of intense suspense."

There is of course in all this a failure to connect by any direct
in of continued observations the swarms that left the Mississippi
ley in 1875 and those which finally disappeared in the region
the mountains and in British America; still less is it shown
t those swarms were the parents of those which are known to
e hatched in the same regions in 1876, or even that those
ich are known to have hatched there were those which descended
n the lower country in July and August. But there is at
t a strong series of probabilities.

great deal has been said within the past two years about the
ctical help which the general government may perhaps find
lf able to extend to the people of the Mississippi valley by
cking the locust in its native breeding-places, and it has been
sidered possible that some means might eventually be discovered
preventing or at least mitigating such inroads as that which
just ended. But if the events of 1875 and 1876 have any such
nection as is claimed for them in the preceding paragraph, if
more northern and western breeding-grounds of the locust
recruited from the lower cultivated regions in alternate years,
problem of how to give practical help to the farmer will be
atly simplified. It would be hard to imagine a method of ex-
ating the swarms or the eggs of a hurrying insect from an
ended area, or perhaps several such areas, of mountains and des-
, the resort of wild beasts and savages, where only armed bands
maintain a foothold; and on the other hand it would be hard
the government to find a time better fitted to begin the exter-
nation of the locust than when the mountain region must be
surably depleted of its stock, nor a place better situated for the
fare than a region where, with any fair assurance of conquer-
a peace, every inhabitant stands ready to do battle.

STARTING POINTS OF INVADING SWARMS IN 1876.

Besides the region named in the article above quoted from the
nnipeg *Standard*, various parts of Montana are known to have
n considerable hatching-grounds during the past spring. In the
marck *Tribune* of June 14th is found the following, which is
ted because it gives an idea not only of the place but of the
ure of a breeding-ground:

"IN THE FIELD, NEAR ROSEBUD BUTTES, May 29, 1876.

As we move westward the grazing improves, and here in the Little
souri Valley the season is at least a month in advance of the season on
Missouri. This would be a splendid grazing region, were the water
d. The grass is heavy and nutritious, but the water is strongly im-
gnated with alkali. Millions of locusts are just now making their

appearance in this region. Too young to fly or do much harm, in a few days, should the winds favor them, they will sweep down upon the defenceless agriculturalists on the border, doing untold damage."

Officers who passed over the country between the Little Missouri and the Yellowstone rivers during the spring, state that at various points in that region young locusts were found in immense numbers. Shortly before the 23d of July, migrating swarms of locusts appeared in the vicinity of Gen. Crooks' camp; "myriads of grasshoppers filled the air, appearing like an immense drifting snow-storm, trending toward the southeast, and apparently taking advantage of a northwest wind to favor their flight to the same fields that they have effectually devastated for two consecutive seasons." (Extract from a letter of July 23d, quoted in the *Pioneer-Press and Tribune.*)

MOVEMENTS OF SWARMS OUTSIDE OF MINNESOTA.

It is difficult to show any eastward movement across Dakota of these swarms that hatched in Montana. At Standing Rock, the movement was from the north. On the 19th of July, quite a large number were observed coming from the north, and by the 26th had about all disappeared from the vicinity of that station. Capt. Poland states that the main body appeared to pass to the west of that station, moving south. No eggs were laid at Standing Rock, or in the immediate region. At Fort Sully, as shown by the records of the Signal Observer, the locusts appeared at various dates from the 14th to the 30th of July, and again from the 10th of August till September 2d; but whenever the direction of their flight is given, it is to the northwest. No eggs were known to be deposited there. At Lower Brule Agency, on the 29th of July, an immense swarm alighted from a westerly direction, and flew again to the northwest, after remaining five days. At different times during the month of August, small swarms, coming from a westerly direction, alighted and died there. No eggs deposited. At Yankton, the course was generally south, through the flying-season.

It is probable that both in 1874 and 1876 the swarms that came into this state, at least in the earlier part of the season, were hatched in or near British America. This is to be inferred from the direction of their coming, the fact that we know of extensive hatching-grounds in British America in both these years, and that we know of no nearer hatching-ground. There is here also a failure to connect Minnesota with any known breeding-place by any continuous observations. But it is known at least that at Bismarck swarms passed south at various times during July, 1876. At Jamestown, (on the N. P. Ry., east of Bismarck,) a large swarm coming from the northwest on the 12th of July, dropped and remained until the 24th when they left, going south. On the 14th of August a very large swarm passed over southward without alighting. At Worthington, D. T., (still farther east, on the Northern Pacific Railroad,) the first flight appeared from the south on the 25th of June, stayed about 24 hours and on a change of wind

went south. For the next six weeks locusts passed over that station in various directions.

At Fort Totten, "in the summer of 1875, grasshoppers hatched in the vicinity of the post, took wing in June, and left in the beginning of July. In 1876, there was no hatching, but they came and departed without doing material damage. They always go and come with the wind. They came about the middle of July, and left in about four days; came again two weeks afterwards and left without depositing any eggs. Swarms generally came from the northwest. They often pass over in large numbers without doing damage."

L. C. HUNT,
Lieut. Col. 20th Inf.

ENTRANCE OF INVADING SWARMS.

The rate at which swarms have been pouring into the state during the summer, may be judged from notes taken at points along the western line of the state of Minnesota, and from the eastern tier of counties in Dakota. I give them in regular succession, from Pembina southward:

Pembina, D. T., Aug. 31, 1876.—"No locusts hatched near here, and no eggs now deposited."—W. R. Goodfellow.

July 8.—"Grasshoppers first observed to-day. They could scarcely be seen with the naked eye, but by using colored eye-glasses they were made plainly visible. They were in great numbers, flying very high, far above cumulus clouds, and in a northeasterly direction."

July, 9.—"Grasshoppers flying northeast.

July 11.—"Grasshoppers, flying high, and moving southeast, were observed in great numbers."

July 12.—"Grasshoppers still appear moving south-southeast, flying very high; can scarcely be seen with the naked eye."

July 13.—"Grasshoppers still continue to be seen moving south by east."

July 17.—"Grasshoppers noted to-day, moving southeast, in greater numbers than heretofore, and flying considerably lower. None have as yet alighted."

July 20.—"Grasshoppers continue to fly over this place, moving from the northwest."—Records of the Signal Observer, J. Kabernagle.

Grand Forks, Grand Forks county, D. T. (nearly opposite Crookston) Aug. 28, 1876.—"A few locusts were hatched here and flew to the southeast early in July.

"A few lit on the 9th of July. They came from the north before alighting, but on the 8th the same grasshoppers flew north and returned next day, a few alighting, and all left on the 10th, without doing any injury—direction southeast.

"From the 10th, all through the month of July, when the weather was fine and clear, and the wind from the north or northwest, more or less of them flew over, moving in a southerly or southeasterly direction. But in no instance have I seen very heavy clouds of them until the 4th and 5th of August, when I was out on the head waters of the Turtle and Big Sault, from thirty-five to forty miles west and northwest of this place, I saw them moving in a southeasterly direction, in thicker and heavier clouds than I ever before saw grasshoppers flying. On the evening of the 5th it rained, and a considerable portion of them fell, and rose next day, moving in the same direction as before. And, strange to say, they rose without much sunshine, as the day was cloudy, and the sun showed itself only at intervals, and that for a few minutes at a time. I never saw them move before except upon a clear, sunshiny day, with a wind favorable to the direction in which they wanted to move. None lit near the Red River at this time.

nor by those alighting on the 5th of August, west of here thirty-five or forty miles."—Hector Bruce.

Crookston, Polk Co., Minn., Sept. 2, 1876.—"On July 10th and 11th, swarms of 'hoppers came from the southwest, and lit at Crookston and vicinity, remaining two and a half days, and without doing any damage worth noticing; they were pairing. They got up on the third day, and went northeast. Three days later, a large swarm passed over us, going east of southeast, coming from the north. July 31st, a few lit here from the west, but doing no damage. August 10th, a few straggling ones came from the north, until August 15th, when they disappeared, going south."—Ross and Walsh.

Caledonia, Traill Co., D. T., (a few miles south of Crookston.) Aug. 30th, 1876.—"No locusts hatched here in the spring, nor were any eggs deposited They began to fly over about July 5th, generally going south or southwest, and for ten days there was hardly a day but what we could see some flying, most always going south."—Ara Sargeant.

Fargo, Cass county, D. T., Aug. 31, 1876.—"A few locusts were hatched here, and flew northeast on acquiring wings. A large swarm alighted on the 18th, and remained two days, without doing much damage. During the last half of July, and until August 5th, extensive swarms were passing over this county. Their destination was determined by the direction of the wind, either northwest or southeast.

"I cannot learn that any eggs have been laid here this season."—A. J. Harwood.

Breckenridge, Minn., Sept. 27, 1876.—"Grasshoppers hatched here from May 23d onward.

June 27.—"First seen flying to-day, few in numbers, going with the wind, from northwest to southeast, between 11 A. M. and 2 P. M.

July 4.—"Flying in great numbers this forenoon from 9 to 11:30, going from the north with the wind.

July 11.—"Hoppers coming down in swarms this forenoon, and flying from the north.

July 12.—"Hoppers left to-day, going south, as there was a strong wind blowing from the north all day.

July 19.—"Hoppers flying from the northwest to-day, in millions. Seen first about 9 A. M., and kept going until sundown; largest swarm seen yet, and looked like a great drift of snow.

July 22.—"A few hoppers seen to-day, flying between 10 A. M. and 3 P. M., from the north, slowly.

July 23.—"Hoppers flying from 9 A. M. to 5 P. M., from the north and northeast, but not in great numbers as on other days, none of them coming down.

July 24.—"Hoppers returning to-day, coming from the southeast, flying with the wind; began moving about 10 A. M. and till 4 P. M. None came down.

Aug. 1.—"Hoppers have appeared again in millions, coming from the north; are destroying the crop in Minnesota and Dakota. But few of them are rising to-day, as the weather is cloudy.

Aug. 3.—"Hoppers still remain, and are destroying everything, crop, vegetables and grass. A few seen flying during the entire day, from the southeast.

Aug. 6.—"Hoppers began to leave about 10 A. M., going southwest; wind very light, and from the west. First seen depositing eggs to-day.

Aug. 7, 9, 10, and 12.—"Hoppers seen flying in small numbers from the southeast; still remain here, depositing eggs."—From the Records of the Signal Observer, M. L. Hearne, M. D.

Wahpeton, Richland Co., D. T., (opposite Breckenridge,) Aug. 30, 1876.—"A few locusts hatched here; so few that the dates of their hatching or departure was unnoticed. Eggs were laid only in scattering spots, after

ugust 1st. They left before the egg-laying was finished."—D. Wilmot mith.

Sisseton Agency, D. T., (opposite Big Stone Co., Minn.,) Aug. 12, 1876.—In the upper portions of the Reservation, twenty-five miles north of the gency, a small quantity of grasshoppers were hatched, in the latter part of ay, and destroyed several grain fields and gardens. At different times in e month of July, we saw them flying over, sometimes in large numbers. nly a few straggling ones came down. The direction has generally been om a point south of southwest.

"On Sabbath, the 30th of July, we had a visitation all over the Reserve. hey came down like snowflakes in winter, and covered the earth. Garden getables, especially beans and onions, were eaten up to the roots. Corn as pretty much destroyed, and potatoes and oats were very much damaged. he wheat was generally ripe, and but little eaten. They commenced leaving about twenty-four hours after they came, but it was the last of the week fore we were free from them. They left on the same line on which they me, going towards the northeast or east of northeast. They were probly the same that have lately visited Herman and Morris, on the St Paul & acific Railroad. I understand they were quite as thick to the west of us, enty miles, as here."—Rev. S. R. Riggs.

[These swarms appear to have reached Ortonville, Big Stone unty, about the first, Herman on the 3th of August. They came eastward from the James river. The ttlers along the James river state that no locusts were hatched ere, and that all that appeared there during the season came om the northwest.]

Gary, Deuel Co., D. T., (Opposite Yellow Medicine Co., Minn.) Dec. 8th, 76. "No locusts were hatched in this county last spring. The first flying arm appeared in the latter part of June, flying northwest and did not ght July 20 a very large swarm came from the southwest and went rtheast; a few stopped and remained about 24 hours.

"August 15, they flew very thick, the largest swarm I ever saw. They me from the northwest and flew southeast. This swarm, as near as I can rn, was about 20 miles wide. [This probably furnished a portion of the arms which reached Le Sueur, Mankato, and other points to the east d southeast on the 18th of August.] August 19th a swarm flew from rth to south. August 24th a small swarm passed from northwest to utheast; and again in the same direction on the the 30th of August. On ptember 4th, 5th, 7th, and 9th small and scattering squads flew over to e southeast."—H. H. Herrick.

Medary, Brookings Co., D. T., (opposite Lincoln Co., Minn.,) August 30, 76.—"The hoppers hatched last spring in this county and the northern lf of Moody county. These became fully developed from the 25th of ne to July 1st, and on the days between those dates they left in great ouds. The favorable winds for them seemed to be from north, northwest northeast. They seemed inclined to go southwest.

"From July 1st until now the hoppers have been seen flying overhead nearly ery day, moving with the wind, most numerous always with northerly ind. These alighted only once or twice in July, but only in small numbers, nd remained only a short time

"On Saturday, July 22d, very dense clouds passed over, (some so low as lmost to darken the atmosphere,) with a northeast wind. They were olng west. I have since learned that they rose from Minnesota, from the tate line eastward.

"On Saturday, August 5th, very great swarms passed from west to east. t that time many alighted on the prairies, but not many in the settlement. he next morning, Sunday, I drove from Medary to Oakwood, about 18 miles north, and when about half way, I could see, for a distance of thirty

miles up and down the valley of the river, dense clouds of hoppers rising. I have since learned that they extended more than 40 miles south of here, and I know more than 20 miles north, making a belt more than sixty miles wide.

"These I note as remarkable displays of hoppers. They could be seen every day, in what any reasonable man would call sufficient numbers. No eggs were laid in this county so far as heard from."—Rev. G. S. Codington.

Flandrau, Moody county, D. T. (opposite Pipestone county, Minn.) Sept. 12, 1876.—"A few hoppers hatched here, but did little damage, and flew to the south and southwest with the army which came over in July.

"The first flying over came about the 21st of July, from a northeast course, and that was the time they visited our crops and made a general raid. Since that time to the first of September, they have been flying more or less, but have done no great harm.

August 6.—"They passed over in large swarms to the southeast. These did us little harm. They have laid eggs to a limited extent in our county."—M. D. L. Pettigrew.

It will be seen from this that swarms from some source or other began to cross the state line to the eastward on July 8th, at Pembina, and that, as a general rule, the date of arrival of large swarms becomes later in the season the farther southward the point of arrival moves. And all these are only the incomings of swarms noticed at prominent points on the border; how many more have crossed or recrossed at other places where there was no one to report their comings, can only be guessed at from the immense clouds that have rolled over the state, passing and repassing each other to the south and east, from the 20th of July to the first week of September. At least one large swarm, in addition to those already recorded, must have entered somewhere to the northwest of Douglas county, shortly before the 18th of August. But whatever form or continuity these bodies may have had before reaching the state, it was soon lost after their arrival. It is not easy to trace them, even from one county to another, as they passed over ground already occupied by earlier comers. All we can say is, that there were extensive movements in certain directions, on certain days.

MOVEMENT OF SWARMS WITHIN THE STATE.

The movement of the various swarms of our own hatching early in the season has been already given. By the 10th of July the counties to the south of the Minnesota river were generally free from locusts, and had begun to congratulate themselves on their delivery. Between the 10th and the 20th the locusts had begun to increase largely in numbers in the northern counties, but the fact that additions had already begun from abroad was not generally known. The greater portion of these had begun to move southward by the latter date and passed various points between Lac qui Parle and Madelia on or soon after July 20th. They passed gradually along over the counties that had been injured during the spring by our own stock, and by the first of August had reached the southern line of the state and many had passed on into Iowa. As they moved along, portions remained

behind here and there, but there was no extensive deposit of eggs until they reached the southern half of the lower range of counties in the state. It seems probable that these bodies also brought with them to the southward, parts of our own hatching swarms that had flown northward early in the month. But by the twentieth of the month the locusts had mostly disappeared from along the lines of the Saint Paul and Pacific, and the Saint Paul and Sioux City Railroads, and there were congratulations once more that "the hoppers were gone." A line showing the eastern limit of their raids at this date would pass, generally speaking, along the eastern boundary of Todd county, through Stearns, Meeker, the eastern part of McLeod, through Sibley, Nicollet, and the northwest corner of Blue Earth, and in Martin county as far east as Fairmont.

Between the end of July and the sixth of August, new swarms had been collecting in Otter Tail, Grant, Stevens, and Big Stone counties, and in some of the eastern counties of Dakota; and on the latter date, a wind from the northwest gave these an opportunity they had apparently been waiting for, and there was a general flying to the east and southeast, over a large portion of the western half of the state. In the southwestern counties, where the new-comers could be traced directly back to Dakota, there was very little alighting, and they mostly passed over into northwestern Iowa. By this raid of the sixth of August, the area of visitation was extended eastward to St. Cloud, into Wright and Le Sueur counties, and across Blue Earth and Martin counties. After the sixth of August, clear weather and favorable winds, at various dates, carried the line still further eastward, as on the eleventh, the fourteenth, and especially on the eighteenth of August, when large swarms flew over Elk River, Monticello, Glencoe, Shakopee, Blakeley, Belle Plaine, Le Sueur, Mankato, and Blue Earth City, and one flight was seen as far east as Hastings. During the week ending August 26th, they were seen flying over or alighting at various times in Rice, Waseca, Steele, Faribault and Freeborn counties, and are said to have appeared over Rochester. By the first of September they had added Waseca, Freeborn, Carver, and portions of Hennepin, Sherburne, and Benton counties to the "grasshopper regions," and some slight additions to the eastward have been made since the latter date.

The comparatively slow rate of progress to the eastward through the season is surprising, considering the long distances which the locust is supposed to travel, and the impression which one receives from seeing a swarm passing in one direction through an entire day. It is easy to imagine that such flights must have come immediately from British America or Montana, and that they will shortly reach Wisconsin and Illinois. But the locust, as it appears in our state, moves (with perhaps rare exceptions,) by day only and often for only a few hours in the day, and a halt for the night is easily prolonged by head winds or cloudy weather into a halt for several days; nor do the swarms move continually eastward, although the line of encroachment is continually moving in that direction. In one case at least, a body that had moved

asterly over a county on the 24th of August, returned direc ly
west one week later. (Freeborn County *Standard*, editorial, A g.
31, 1876.) There is no knowledge that any swarm has (in Min e-
sota) reached the Mississippi river south of Hastings.

But the general direction of movement since the twentieth of
July has been to the southward and eastward. The experience of
the summer has shown that the Big Woods offer no impassi le
barrier. Hitherto, the incoming swarms have reached about as
far east (but not in great numbers) as Lake Washington, in Le
Sueur county, longitude 16° 50' (nearly) west. They have reach ed
this point toward the end of August, when impaired in streng th
and activity. But the invasion of the past summer has be en
characterized by the incoming of fresh and still active swar ms
late in August, and these have been carried by winds blowi ng
freshly from the west, as far east as Mower county, longitude 1 6
west. It may be proved in future that the eastern limit of i n
vasion is determined solely by the extent to which winds prev ai
from the west, together with the length of the season duri n
which the locust retains its full activity and strength. The co n
nection between the movements of the locust and the prevailin
direction of the winds, seems likely to receive more attention tha
has hitherto been paid to it. While the timbered country of th
northeastern part of the State has been but little infested, to an
great distance east of the Mississippi, it may be said that th
portion of the state does not lie in the direct line of invasion s
There is nothing to show that swarms purposely turn aside fro r
the heavily timbered regions and go elsewhere, although in pa i
tially timbered sections they alight mostly in the open farm s
But, having once entered the timber, their progress is soon ende d
and no more fortunate destination could be selected for our depar t
ing swarms than Northeastern Minnesota. Locusts have bee n
quite numerous about Brainerd throughout the summer, sinc e
early in July, and their numbers were perceptibly increased on th e
sixth of August, apparently brought in by a strong wind from th e
southwest: but these evidently found their progress impeded b y
the timber, for they did not extend to any distance east of Brainerd,
along the Northern Pacific Railroad, nor did they lay eggs exten n-
sively about Brainerd.

The connection between flying movements and the direction of
the winds may be shown by the following diary kept by Lieut. R.
B. Plotts, of Elk township, Nobles county:

July 5.—"Light wind; first flight came from the northeast, and commenced to settle down about 10 A. M.; attacked gardens first of all. They remained here till Sunday, the 9th, when in a brisk breeze from north-northwest, a light rain the night before, they flew from early in the morning till after sundown, and lit heavily south of me.

July 10.—"Wind southeast; flew heavily to the west, the highest appearing to sheer off southwest. Got a heavy light from those east of me.

July 13.—"Late in the afternoon wind suddenly veered to northeast, and they started immediately. Nearly all left me.

July 15.—"Wind north, veering to the east. Not a very heavy flight to the west.

July 17.—"Wind east, trending north, showery. Before the show commenced, could be seen going west. That ended the first raid. No mo flying over till

July 20.—"Second raid came in on a west-northwest wind, and lit night.

July 22.—"Wind north-northeast, heavy flight, and coming down all da

July 23.—"Wind northeast, hauling east. Heavy flight; came down heavi and covered everything nearly.

July 24.—"Wind varying from north-northeast to east. Coming and goi all day; some commenced laying eggs, which was kept up till this raid left us.

July 27.—"Wind from north and east. Heavy flight, and most of the left here.

July 29.—"An east wind took all this raid away, the upper current bei to the southwest. No more flights until

Aug. 6.—"Light wind from northwest. Another heavy raid came These remained till

Aug. 10.—"When wind again came from the northwest, and it rained. soon as the shower was over and before the sun shone out, the hoppe started in heavy flight.

Aug. 12.—"The red mites were first noticed doing much damage to t eggs.

Aug. 13.—"Another showery day, and immediately after the rain th started south.

Aug. 14.—"Wind from north and north-northeast. They started early a before the sun came out, although it was quite cool; about all of this ra left.

Aug 16.—"Very cloudy, with variable winds. Suddenly, while it was qu dark with clouds, the hoppers jumped up and flew off southwest; the ve first puff of wind from the northeast, and they all left here.

Aug. 18.—"Wind again from the north. A very heavy flight passed ove high up in the air. None alighted. Red mites disappearing.

Aug. 23.—"Wind hauling to westward, and some few stragglers flew near south as they could.

Aug. 24.—"Wind northwest. Grasshoppers very high and heavy flight the southwest.

Aug. 25.—"Wind northwest. Heavy flight to the southwest, very high.

Aug. 31.—"Showery for several days before; wind suddenly north-nort west, and by 10 A. M. many grasshoppers were flying. By noon, in the u per air and almost indistinguishable, was a heavy body going southwes None lit here.

"On the dates intermediate between those given the wind was very ligh and there were no flights, except perhaps short ones, from one part of a fie to another.

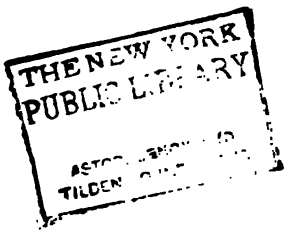
"When the directions of flight are not expressly stated, they correspo almost exactly with the direction of the wind."

AREA OF THE PRESENT DEPOSIT OF EGGS.

A line showing the eastern limit of the area where eggs are no deposited in Minnesota would include (very nearly) the weste tier of towns in Mower county, the western part of Steele, Ric and Scott counties, the whole of Carver, the western part of He nepin, along the river, (and in many places thickly in the timb farms,) in Sherburne and Benton counties, the southern part Todd county, then westerly including Otter Tail, the southweste part of Becker, and portions of Clay counties. To the south a west of this line the locusts have had possession of more or le of the state from the fourth of July to the first of October, and would be difficult to specify with any exactness especially in t

These eggs have been deposited, as a general rule, in the vicinity of cultivated fields, and in each township the extent of the deposit is measured, in some degree, by the amount of land under cultivation. It is not presumable, at least, that wild prairies or lands lying far distant from tilled fields, are extensively filled with eggs. The locust is attracted and held by the growing crops, and it seems to be something more than a mere coincidence that the area devastated by the young in the spring does not become a laying-ground in the summer; this is especially true of the present year, and the same strip of country where the locusts hatched in the spring, and where the little that was planted, was mostly consumed by them, is at present exactly that portion of the infested area that is now most nearly free of eggs, although the deposit is abundant enough in the counties to the north and south of it. Nor do the prairies, when covered with grass, present many favorable situations for the deposit of eggs. The experience of the summer would seem to show that almost any bare, sunny spot, where the earth is hard enough or moist enough to retain the shape of a hole, is selected by the locust when she is ready to lay. To what extent the prairies in general are filled with eggs, cannot be told, of course, until the time of hatching arrives, but in the vicinity of cultivated fields the wild prairie has received its share of eggs. Throughout the whole area already given, with the exceptions named, there is hardly a town where the deposit was not so extensive by the first of October as to form one of the most serious of all considerations for next year's crop. These eggs are laid sometimes in ground so hard as to resist the point of a knife-blade, sometimes in sand-heaps so soft that the next shower washes off the sand and leaves the egg-cones standing like pegs in the ground; on knolls high and clear of all moisture, on sand-bars in the rivers,

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in flats so low as to be overflowed by the next rain. But the st favorable spot of all, everywhere, is new breaking. Grain ls have generally suffered most damage on the sides nearest to r breaking, and, conversely, in new breaking more eggs are laid the sides nearest to grain fields. In some counties, a large ount of new breaking has been done by non-residents, and will ish a fruitful source of evil next spring. Of circulars sent to rly all the infested towns to ascertain the extent to which eggs e deposited during the season, the following, from Blue Earth nty, is a sample of all, as to the extent of the deposits, and the ts where they are situated:

eauford.—"All over the town; not much in the stubble, but on all bare ts, such as sheep-pastures, between the rows of corn and potatoes, gar-s, all places that were clean of weeds, river bottoms, where fed close, otby stubble and road sides."—J. S. Larkin.

utternut Valley.—"It would be difficult to run down a spade and turn dirt anywhere in stubble, corn, potato fields, meadow, or road, with-finding eggs. It seems as twenty to one before, and they destroyed rything."—Samuel D. Shaw.

eresco.—"Over the whole township, very thick in most places."—J. M. id.

imestown.—"They have deposited their eggs on nearly every farm in township."—A. P. Davis.

idson.—"They have laid eggs very extensively, especially on new breaking roads, some in the stubble, grass, prairie and corn lands."—Humphrey ones.

ray.—"Eggs are laid on every clear, dry place in the town; mostly in fields, potato fields, gardens, and in the highway."—Ira B. Reynolds.

me.—"In the flats along the Minnesota river they are thicker than in timber, but along the roads, and in old pastures, they are so thick that dy can have an idea, unless he has seen it himself."—Jacob Born.

apleton.—"There is not a farmer but claims that every favorable spot is farm is thoroughly peppered."—J. E. Brown.

edo.—"All timothy pastures, all new breaking, in the roads, and in some ble to a limited extent—from 6 to 10 acres in each quarter."—B. F. dman.

pidan.—"Every favorable place is well filled; roadsides, tame pastures, ew breaking thickest, corn fields next, and stubble fields and unbroken le least."—James B. Swan.

elby.—"All along the highways and especially on all new breaking and astures, corn fields and prairie lands that are eaten out by pasturage, n fact there is no such thing as exception from them."—Thomas J. s.

uth Bend.—"Eggs are deposited in every rood of dry ground in the ship."—D. P. Davis.

erling.—"In some places the eggs are stuck in very thick, but in the

fields generally the eggs cannot be very thick. Still, in the aggregate there are very many, being everywhere, even in the timber."—N. A. Hunt.

Vernon Center.—"Eggs are deposited all over the township, and in some places very thick, seemingly no room for more, and in other places (wheat stubble,) not so many."—E. W. Washburn.

The laying this year seems to surpass that of former years not only in the area filled, but in the numbers deposited everywhere. This could hardly fail to be the case when the laying commenced early in July and was prolonged into September, and when some towns received deposits from two, three, or even four different bodies. Where new breaking was harrowed in the fall the eggs often appeared strewn on the surface as thickly as grain is sown; e. g., "I have just dragged a new piece of breaking, and the eggs were as thick as wheat sown at the rate of one and a half bushels per acre; but I think they are thicker on breaking than anywhere else. (S. S. Clevenger, town clerk of Bismarck, Sibley Co.)

TIME OF DEPOSITING EGGS.

The time when eggs have been deposited this year has been stated already. The time when, or rather the age at which the Rocky Mountain Locust deposits its eggs, is a different question. The same species has laid eggs in Kansas, this year, as late as the 13th of November, and may continue to lay in Texas as late as the first of December. (Riley's 7th Ann. Report, p. 192.) If the mission of the locust is to lay eggs once and die, what could be the time or place of birth of those insects which have apparently just reached maturity by the first of December? Although it has been considered possible that these are a second brood whose parents were hatched in the preceding April or May in Texas or Colorado, there is no knowledge of the time or place of any such second hatching. If these late laying swarms are such as those which come down from the Snowy Range in Colorado, in the latter part of August (vide N. C. Meeker, quoted in Riley's 8th Ann. Report, p. 84) it must be admitted that the mountain-born broods are a longer-lived and more vigorous race than any bred in Minnesota. Besides this, among the swarms which have come in upon us this year, many were found dying as late as October, containing eggs. That the Rocky Mountain Locust lays eggs twice or three times in a lifetime, has been the result of some guess-work among our farmers, who considered it necessary in order to account for facts as they saw them. I give the result of a single experiment.

On the 25th of June, I shut up in wire gauze cages nine pupæ of the Rocky Mountain Locust. The bottoms of the cages were filled with earth packed hard, and the insects appeared to thrive in confinement. By the second of July they had all become perfect insects. By the 8th of July they commenced coupling, and were seen repeating the act for several days. On the 15th and 16th two of the females went through the form of depositing eggs, and I marked the place of deposit on the edge of the cage. The coupling was repeated again as before, until the third of August. At that

date the coupling ended, and the locusts became almost inactive, and were seen to eat very rarely afterward.*

On the 14th of August one of the males died; the female died on the 9th of September, and was found to contain fourteen full sized eggs, but I found on examining the cage that there was also a full sized egg-cone where she had already appeared to deposit on the fifteenth of July. Of the rest of the Rocky Mountain Locusts the males were caged with some female Red-Legged Locusts caught in my garden, and although the two species did not seem inclined to have much commerce with each other, I saw one pair coupling. These observations are very slight and imperfect, but are given for whatever they may be worth. That the male dies first may be inferred not only by the above experiment, but from the fact that in September it was common to find many pairs coupled, of which the female was alive, but the male had died without releasing himself.

PARASITES AND ENEMIES.

The various insect enemies of the Rocky Mountain Locust have been described sufficiently for common information by Prof. Riley on pp. 44-46 of the "Report of the Proceedings of a Conference of the Governors of several Western States and Territories, at Omaha, Nebraska, in October, to consider the Locust Problem." As the descriptions are further illustrated by figures, and as the pamphlet is intended for public distribution it may serve to prevent some of the confused knowledge about these parasites and enemies which has heretofore prevailed to a considerable extent. The amount of help which may be expected, or has already been received, from these enemies of the locust is, in *limited areas*, even greater than Prof. Riley would assign to them. There are farms where in loose, mellow soil it is now almost impossible to find eggs, yet but a short distance away eggs may be found in abundance in hard ground. There was also great difference in the different flying swarms in regard to the presence of the internal grub. While in some places hardly a locust (one out of five,) could be found that was not affected by some internal parasite, in others they were almost entirely free from them. Mr. W. C. Ralls, of Le Sueur, examined 624 locusts between the 7th and 10th of September, and in 9 of these the grub was found, and in 10 the hair-worm. It would be well if we could add to this help which is given without expectation of bounty or relief, the help which might have been added by thousands of prairie-chickens killed during the fall. When a whole community stands in need of every form of assistance that

* The early part of this coupling season was one of the greatest activity on the part of these insects; they dashed themselves against the wire of their cages as though all space would be too small to contain them; there would be a flash of the wings, extended and closed again in an instant, or that movement of the hind legs known as "fiddling," which seemed to be a well known signal between the male and female. In cages, where several pairs were confined together, the male, while in the act of coupling, would repeat this movement, if brushed against by another.

man and nature can render, it is worse than useless to throw away the help, however slight, that any willing instrument is ready to contribute.

DAMAGE TO CROPS.

The form and substance which this report might have been expected to assume early in the season, have changed considerably under changing circumstances. The various means of contending with the locust have been set forth generally and in detail during the past four months; and the amount of damage which has been inflicted upon the crops, while it might have been ascertained with some precision in five or six counties, has become a different matter when combined with severe losses by drouth, and extending over thirty-five or more counties. The exact amount of loss in so many different counties, varying as it does from almost total loss of the grain crops to slight injury to gardens and late corn, can not be arrived at with any less efficient machinery than that of the Commissioner of Statistics, to whom the whole of this portion of the subject properly belongs.

Of grain, the oats and barley have, as usual, suffered the most: in Raymond, Stearns county, where the locusts were most numerous from the 23d of July to the 20th of August, "the Lost Nation wheat was only slightly damaged, while the Fife wheat was ruined." (So stated by L. B. Raymond, Esq.) The same fact was noted by P. Hoffman, Esq., of Westport, Pope county; but it is not known how generally the rule will apply.

Corn and potatoes have escaped with less damage everywhere, though corn attacked in the silk has been ruined. Peas are never specially mentioned except to note their escape from injury. ("On the whole, we consider peas and potatoes the best crop to raise."—S. S. Gillam, Big Bend, Cottonwood county.) Sorghum is almost locust proof so far, both against the young and old. Flax, tobacco and beans are generally mentioned to note their almost total destruction. Farms lying on the east side of lakes have often suffered less than others, both in this state and Dakota. In some cases farms situated in the timber have been passed over altogether; in others they have yielded 5 to 10 bushels to the acre, while crops on the prairies in the same town have been failures; on the other hand, rarely the timbered portions of a town have suffered more severely than the prairie farms.

PRACTICAL METHODS OF CONTENDING WITH THE YOUNG LOCUST.

The different means of contending with the locust both in the egg and the unfledged state, have been set forth so fully and so often within the last two years, that they ought by this time to have reached, in some form or other, the hands of every reading man in Minnesota. The report of the commission appointed by Governor C. K. Davis in 1875, (of which some 5,000 copies were printed,) the proclamation of Governor J. S. Pillsbury, issued August 30th, 1876, containing the gist of all the known methods

of locust warfare, and the many and oftentimes excellent amplifications and details of these methods, as they have appeared in the state newspapers during the summer, cover the whole ground so far as it is known. Finally the Report of the Proceedings of the Omaha Convention repeat, in twelve excellent pages, the whole subject once more, and a reprint of these in the newspapers of those counties where the evil is new and comparatively unknown, ought to leave no further lack of information.

It ought also to be understood that these sources contain all that has so far been made public on the subject, and that the farmer must for the present defend his crops by these means or not at all. We are so accustomed to the comprehensive methods of farming by machinery that it is hard for us to come down to the petty exercise of individual exertion which the European peasant would consider only a regular portion of his daily existence. But whatever may be the success of various machines and applications which are now in preparation, but not to be disclosed at present, there is as yet no labor-saving contrivance, capable of being applied over large areas, which can accomplish anything like a universal destruction of the young locust, and the general law of labor holds good, that a man's success is measured by the earnestness of his own endeavor. Even the difficulty which results from sparseness of population may be overcome in some little measure; where a few farmers in a township where eggs are laid have determined to sow a small acreage and to defend it to the best of their abilities, something may be gained by combining and sowing in partnership, or side by side, the fields that would otherwise be distributed over a township. Of course there are objections and difficulties to any such method of proceeding, but they are at least no greater than those already presented in the mere fact that the locust is present. On the other hand the advantages would be great; half a dozen families acting in concert and in the defense of one large field would accomplish far more than by any disjointed efforts; it would be far easier to defend the four sides of one large field than the twenty-four sides of half a dozen smaller ones; and lastly the single field would have a smaller number of locusts in the aggregate to contend against, and insects hatched at a distance from it might never reach it before flying; at least it is certain that fields lying within three miles of the hatching grounds of last spring, remained untouched until the flying season.

WHAT MAY BE DONE BY ENERGY AND PERSEVERANCE.

Although it is impossible for me to add at present anything to the many and various methods of locust-warfare that have been repeated so often, it may be of some value to show what has been or may be done with those already known. It was not as a mere form of speech that the conference at Omaha concluded with these words:

"That our consultation with each other and with those who have tested the matter, has resulted in the firm conviction that

by proper efforts, concerted action, and a vigorous and determined warfare against them, the young grasshoppers which may be hatched out next year, or any subsequent year, can be successfully fought and our crops saved; that we are not without remedy, but we may protect our crops against them if we will but make use of the means within our reach."

The conditions of success here noted, "proper efforts, concerted action, and vigorous and determined warfare," have never yet been applied in Minnesota. The truth of the above quotation, is shown by the fact that where even individuals, contending not only against the locusts hatched about them, but against those which the concerted action of their neighbors should have rendered harmless, have defended their crops with perseverance and determination through a whole season, they have in the end received a return which justified both their usual and their extra labor. Even the most petty means of defence, if kept up persistently through a whole spring, will often effect a saving of a considerable portion of the crop. The town of Lime, in Blue Earth county, one-half of a government town, in 1875 turned out its whole population to battle with the young locusts with brooms, switches, and every weapon they could lay hands on, and returned an average crop of 12 2-3 bushels of wheat, 36 bushels of oats, and 36 bushels of corn to the acre. The town reported no damage from locusts, and the return was about the average crop for the whole county, and a fair yield.

Charles Pelzel, of Milford, Brown county, by spreading tar over strips of building paper, and placing these along the sides of his fields, saved most of his crop, while those of his neighbors were badly damaged. The paper was re-spread with tar as often as it became covered with young locusts. On 25 acres of wheat he saved 223 bushels, and on eight acres of oats 400 bushels. All this was at a cost of $3 for tar.

Mr. N. V. McDowell, of Bigelow, Nobles county, who has fought the locusts persistently ever since they came in 1873, by 10 days' extra labor in hauling and burning straw, saved a fair crop on 55 out of 70 acres cultivated, but his exertions were rendered useless by the raids of July and August. Even after these he was able to harvest five bushels of wheat to the acre on early sowing.

The only crop of small grain harvested in the town of Holly, Murray county, this year, was by Mr. J. M. King. He writes:

"I put in about 50 days' labor for one man. I caught 100 bushels in my net, and destroyed as many more by scattering straw over their hatching grounds and burning them. I also put to flight swarms and droves of them after they began to fly by use of bags nailed on to from 25 to 50 feet of pole or board, with which I trailed back and forth across my fields, at times driving them like sheep, and at other times not making much impression. I saved 450 bushels of wheat from 52 acres, but firmly believe that if we had had a favorable season, the hoppers would have hurt it but little; but the dry weather, coming as it did, seemed to kill it."

The following experience is also worthy of being recorded here:

"Mr. S. W. Danforth, of Madelia, Watonwan county, after having or[illegible] re-

solved (in 1874) that he would put in no crop whatever should the locusts deposit eggs on his farm a second time, resolved once more in 1876 that he would determine whether he or the locusts should be master of his farm. On the north side of his wheat field was a prairie ridge where the locusts hatched in the spring. These, while very young, began to come into the field on the north, and had reached it before being discovered. He began by burning them with straw on the edge of the field and on the adjoining prairie, constructing a ditch along the side of the field at the same time. Smaller ditches were also made inside the field to stop those which had already entered. When young, they were also delayed by simply harrowing over the soil and presenting a rough surface for them to crawl over. Seven or eight days were spent in this way, and after the ditch was finished, it turned away the locusts so completely that the work was considered done, and the crop saved. On the western edge of his field was a strip of prairie grass, 40 rods wide, and beyond this some stubble and old corn grounds, belonging to a neighbor. Here the locusts hatched out abundantly. About a week after work was done on the north side of the field, these had crossed the strip of prairie and entered the field from the west before being noticed. As soon as they were discovered, he got all the help he could and made a ditch as fast as possible. This stopped them for nearly a week, and then they began to cross it. He hitched a horse to a plank and walked him up and down in the ditch, and this turned them aside for a while. There was a cloudy day on which the locusts rested, but when the sun came out they were ravenous, and there was no stopping them. They crossed the ditch, and filled the straw-fire so full as to extinguish it. He called in his neighbors to see what would happen to them if the locusts were allowed to keep on in their course, and five or six turned out with teams, hauling straw. With this they burned over a strip three or four rods wide and a hundred rods long, along the edge of the field. But in spite of all his efforts, the locusts had made their way into his wheat, and by this time he had finished a catching-net. The next day, in five hours, he caught from 15 to 20 bushels. This was continued daily, until 75 or 80 bushels had been caught, and it was not necessary to use it, except as occasion demanded on certain days, or in certain spots where the locusts were thickest. This work was so effectual that there should have been (except for drouth) a fair crop of wheat, or at least half a crop all over the farm, except where the burning was done. This demonstrates the possibility of one farmer's fighting two farmers' locusts, and still saving half a crop."

CATCHING-MACHINES.

Many other isolated cases of persistent and partially successful efforts in saving crops from the young locusts have occurred this year; I mention these because they have been reported more fully than others. It also shows what can be done with machines in the later part of the season, and what might have been done by attacking the locusts in their hatching-grounds instead of waiting for them to approach the grain. The coming spring seems likely to test what can be done with catching-machines. Not only are several elaborate ones patented or prepared for use when the time comes, but many farmers are already preparing such machines after their own fashions. To those who are deterred by cost or by lack of a model, it should be said that an efficient machine can be made at a cost of a few poles or strips of board, a pair of wheels, a few yards of stout canvas, and just sufficient ingenuity to construct a long, open-mouthed bag to run over the fields with its lower edge near the ground, and running back in the rear to a sack to contain the locusts that are caught. Mr. King's net was such, and cap-

tured from two to eighteen bushels per day, depending on the size and age of the locusts.

Mr. Danforth's machine consisted of two wheels, connected by an axle 20 feet long and six inches in diameter; this was made of a stout pole obtained from the woods, and it was necessary that it should be so large and strong, for the loads of young locusts captured were sometimes so heavy as to bend even this badly. Across the top of this axle two poles, of about the same diameter as the axle, were fastened, running back nearly to a V some eight or ten feet behind the middle of the axle, and extending forward and opening out in front of it. The front ends of this V was steadied by a cross-piece. This was the frame-work. The net was made of about 40 yards of cotton cloth, cone-shaped, in front about 18 feet wide, from one side to another along the axle, and six or eight feet high from the ground to the top of the net. This net narrowed back about seven feet until it was some five or six feet in diameter, and terminated in a stout canvas bag three or four feet long, closed with a string at the rear end. The heavy loads of locusts caught (sometimes 500 pounds) made it necessary to have a support for the net and bag, and for this purpose a triangular floor-work of boards was made, the front end supported from the axle, and the hind end from the hind end of the V poles, and running as near the ground as possible. The lower edge of the net in front was kept close to the ground by a piece of light scantling fastened to the edge of the cloth, and rising and falling over uneven surfaces. The horses were hitched to the ends of the axles, outside of the wheels, their breasts extending forward nearly to the front ends of the V poles, where they were fastened by the head. The net sloped backward at the top in front, and when the machine was in motion a man stationed on the axle with a broom gave the locusts as they entered the net a start toward the rear end. Just where the cone terminated in the oblong bag, a large piece of canvas had been cut out and wire gauze inserted, and the locusts moved towards this on getting into the net, attracted by the light. The only outlay in constructing this machine was for the 40 yards of cotton cloth. This net captured from eight to twelve bushels of pupæ per day when first used, and the amount diminished daily till the 24th of June, when about two bushels were taken.

Mr. Andrew Webster, of Norseland, Nicollet county, had, in 1875, about 230 acres of wheat sown. The locusts began to hatch about May 17th, and he commenced at once to destroy them by burning with straw. As it was impossible to protect the whole of his crop with the help at hand, he selected a field of fifty acres to defend, and burned all the locusts that hatched near it. This continued until June 11th, when the straw was exhausted, and the locusts had begun to come in from the adjoining fields. Two catching-nets were then rigged up, (of the usual form,) attached to axles fourteen and sixteen feet long, each drawn by one horse moving at a fast trot. The amounts caught were: From June 11th to 17th, (part of the time with one net,) 121 bushels; with both nets, June 17th, 37 bushels; June 19th, 20 bushels; June 21st, 77 bushels; June 22d, 63 bushels; June 23d, 45 bushels;

June 24th, 71 bushels; June 26th to 28th, 128 bushels; June 29th, 59 bushels; June 30th, 28 bushels; July 1st, 18 bushels, when the work was discontinued, as the locusts had begun to fly, and had become too scattered to be caught easily. The catching was done along the edge of the field, and between the hours of five and ten P. M. It required the labor of four men and four horses during these hours. The whole number of bushels caught was 667, and, on threshing, 658 bushels of wheat were harvested from the fifty acres.

DITCHING.

The experience of Minnesota in regard to ditching, in 1875, was so successful, and so strongly and fully confirmed by the testimony of reliable men, that the experiment should have seemed worthy of a more extended trial than it has received this year. But few ditches have been dug, but these, even when left to take care of themselves, have generally served as a barrier during the earlier half of the season. A ditch, to be effectual, needs care and watching; when its sides have been washed down by repeated rains, and it becomes a mere curved surface, it is a very slight barrier indeed. The time and trouble of constructing such ditches as these, would be spent better otherwise.

CONTENDING WITH WINGED LOCUSTS.

Here and there during the past season have been cases of one farmer or a few farmers in a township who were able to save some portion of their crops from the flying swarms. The number of cases where this has happened is in some twenty-five or thirty out of the whole number of towns in the state that have been invaded. When there has been any success at all it has generally been early in the season, and over small patches of garden or cornfields. There are towns where farmers have smudged, roped, discharged fire-arms, and rattled tin pans, until straw stacks and patience were exhausted; and all to no avail. Others have worked hard smoking and roping their fields, supposing all the while that they were accomplishing something, only to find in the end that they were worse off than neighbors who had done nothing. Others, who have had plenty of straw at hand, have, by firing it at just the right moment, managed to save a field. But the uselessness of all such attempts has generally been too apparent to encourage any hope of even a chance of success.

BURNING PRAIRIES.

The amount of help which may be received from burning the grass on the prairie at the time of hatching, seems likely to be well tested next year, as the efforts to preserve the grass have so far been generally successful. The exact amount of help that can be derived from a general burning must vary much, with differing circumstances, from one year to another, and the opinions as to

its value differ greatly. To those who believe that the whole region of uncultivated prairie in the western part of the state is extensively dotted with eggs, nothing could seem more important than a general preservation of the grass, difficult or impossible as this may be. There is no question whatever as to the value of preserving it in all cultivated neighborhoods, or in all regions that are interspersed with farms. And yet even in these it is difficult to select a time for burning which will not allow the escape of some portions of those already hatched or of those still unhatched. But even if the help falls a great deal short of general destruction it is still a help; even if no insects are hatched on the prairie they often hop away in large numbers off the bare fields into the prairie grass, and may be destroyed in large quantities. In addition to this, where the grass is burned late in the spring it gives place to a growth of young and tender grass which often serves to entice the locusts away from the crops. In Watonwan county last year only about one half of the grass was saved through to May or June, in Cottonwood county less than one half, in Redwood, Murray and Lyon counties, hardly any. Wherever it was fairly tried in Cottonwood county, those who had charge of attending to the preservation and firing of it are strongly convinced that efficient service was rendered by it.

PLOWING AND HARROWING.

The prevention of the eggs from hatching by deep plowing or by surface harrowing has been urged in the Report of the Omaha Conference, and none too strongly. While there is much difference of opinion in regard to deep plowing, there is strong testimony to show that where the eggs are turned under to the depth of ten inches they either never hatch at all, or come forth so late as to be incapable of harm, appearing sometimes after the corn has reached the height of three or four feet, sometimes as late as the end of August. But if there is any point in the whole subject where opinions seem to be unanimous, it is in regard to the value of harrowing up the eggs in the fall, and exposing them to the influence of weather, birds and other enemies. In this connection the general harrowing of new breaking and plowing of roadsides that have been done by many farmers, or by townships, cannot fail to be of benefit. That this work should commence in our climate as soon in the fall as there is any assurance that the egg-deposit is ended, is evident from the consideration that the longer the egg is exposed to the above mentioned influences the more sure its destruction is likely to become, and from the fact that in many places the ground became frozen before the work of harrowing was nearly finished.

THE NEED BOTH OF STATE AND OF INDIVIDUAL EXERTION.

It will be fortunate if science and national discovery shall finally be able to dispel for us some of the uncertainties which beset the locust problem in general. It is the doubt in regard to the

future and the fear that each year may prove more disastrous than its predecessor, that give the evil more than its real magnitude and paralyze hands that are not otherwise accustomed to refuse labor. To simplify the conditions of the problem as far as possible, to determine how far the goings and comings of a fitful insect hurrying destructively over thousands of miles of grain fields, and sowing everywhere the seeds of future devastation, may be foreseen or prevented, is an object worthy of the highest science and the most liberal enterprise. But the help that can come from any such source must necessarily be long in action and slow in results. With all our uncertainties, we have one certainty before us in the immediate future; it is that of a great and wide spread injury which only prompt, efficient, concerted and continued effort can remedy. We cannot offer to do less than to render at once by ourselves and to ourselves a portion of that help which we ask a broader knowledge and enlarged means to render unnecessary in the future. The state of Minnesota has already taken the lead in the proposal of a conference upon the locust subject, which, if the results correspond in any fair measure to the objects proposed, will end in more definite knowledge and more efficient action throughout all the region that has been overrun for so many years. The state may fitly supplement the action of the conference by determining once for all just what can be done with the evil when it has taken root here. It is no longer a question that that is a state matter which concerns more or less intimately forty-four out of seventy-one counties.

But the matter does not end with the state. After all that can be done by legislation, success depends purely upon how much each man is willing to do with his own hands. Without united effort to meet the evil wherever it occurs, and with every means or instrument that lie at our disposal, without a determination to plow and sow and defend, each and every man on his own domain, nothing will be done that is worth legislating about. No effort is worth securing that does not recognize the need of the broadest possible exertion, or offer the largest possible assurance of ultimate success.

BOUNTY.

The conference at Omaha, while recognizing the necessity for united action, both of the state and of every individual throughout the present infested regions, resolved "That it will be wise and politic for the legislatures of each of the states and territories most deeply interested in the locust question, to enact a state bounty law," etc. As there is in the minds of many a grave doubt as to the expediency of offering any bounty at all which shall take the form of a specified amount to be paid per bushel for locusts, and as it will be difficult to enact any law which shall be equally adapted to the thickly settled counties and the thinly settled frontier, I have included in circulars to the different towns the question, "If a bounty were offered in your township, next spring, for the destruction of locusts, could it be made to any

extent successful in saving crops?" and "How small a price per bushel would accomplish the purpose?" The farmers ought to know at least as well as any one the capabilities of their own communities, and it is some proof of the sincerity with which they have made their replies, that in counties where the locust is comparatively unknown, it is answered that they are unable to give an opinion; in the sparsely settled counties, the fear is often strongly expressed that such a bounty would be useless for the purpose stated; while in those counties where the locusts have hatched of late years or where the bounty system has already been applied, it is considered that a bounty per bushel would undoubtedly accomplish the object named. The amount is generally placed at one dollar per bushel, seldom more, and often one-third or one-fourth of that amount; and while one dollar per bushel might be none too great a price per bushel for locusts immediately after hatching, it is certain that in a very few days a much smaller amount would more than equal it.

By referring to the experience of Mr. Andrew Webster, already given, it will be seen that from the 11th of June to the first of July, even ten cents per bushel would have been a paying bounty, when added to the crop that was saved by the exertions made in catching. With the improved machines and contrivances for capturing that are being brought forward at this date (Jan. 30, 1877) it is certain that the state need not offer a larger bounty, at the utmost, than ten cents per bushel after the tenth of June. If the locusts exist in sufficient numbers to do great injury after that date, a few cents per bushel added by counties, or by towns, to the amount given above, will make a bounty that will amply repay labor, to say nothing of the saving in crops It would be also an improvement, both in convenience and exactness, if a bounty were offered per pound, instead of per bushel. It is no pleasant matter to measure a few bushels of locusts that have been standing for a day or two under a hot June sun, and the hurry of an unpleasant task may be a cause of inaccuracy in measurement; but the measure in pounds of almost any quantity of dead locusts can be obtained at once, with ease and accuracy.

CONCLUSION.

In conclusion it remains to thank the many persons, both known and unknown to me, who have so kindly replied to my circulars and letters of inquiry during the season. The writers are so many that it is impossible to name them, but they have helped greatly to give this report whatever value it may have. This value must necessarily appear different to different readers; many will miss what they expected to find, or find what may appear of comparative little value. But I have endeavored to compile from all available sources what might be of benefit to our citizens and at the same time worthy of appearance in a report upon the Natural History of the State; I have tried to show not only the requirements of the present year in meeting the locust evil as we find it upon us now, but also the connection between one year

and another. But whatever the value of the report may be
State should provide fitting means for the continuance of sir
(or better) efforts during the year 1877. Not only is an enter
of this sort, if properly conducted, always a worthy one in
State which labors under an evil of such magnitude, but the
which a national commission may derive from assistants ac
under its direction in every one of the States now infested
be of great value, and will help to bring completeness to a
which any commission will find too widely extended to reach
personal observation. There is no need to regret the tri
sums which have so far been expended upon "grasshopper ir
tigations," nor to begrudge the few hundred dollars that
enable us to do what little we can in aid of that scientific inq
for which we now ask of the National Government compe
maintenance and the best learning that America can supply.

Respectfully submitted.

ALLEN WHITMAN.

VIII.

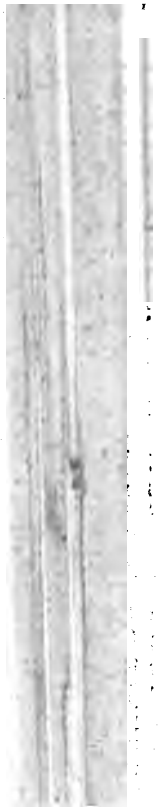
THE GEOLOGY OF HENNEPIN COUNTY

Situation and Area.

Hennepin county lies west of the Mississippi river, and in angle formed by the Minnesota and the Mississippi. It exte thirty miles north and south and about the same distance east a west, but its form is more that of a square with rounded corne Its aggregate area is 354,904. 96 acres, as follows, by towns. T tabulated statement was furnished by Mr. F. E. Snow, under direction of Sur. Gen. J. H. Baker, St. Paul.



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Surveying Statistics of Hennepin County, Minnesota.

Township.	Range.	TOWNSHIP LINES. When Surveyed.		SUBDIVISIONS. When Surveyed	Acres.	Remarks.
27	23					Frac'l Ft. Snell. Res'n.
28	23	N. & W.	July, 1853.	August, 1853.	1,304.67	" " "
29	23	N. E. S. W.	Oct., 1847.	Oct. Nov., 1847.	3,126.94	East of Miss. River.
29	23	S. & W.	July, 1853.	July, 1853.	434.62	West of Miss. River.
27	24	N. E. W.	July, 1853.	August, 1853.	14,251 79	Frac'l Minn.R.& Res'n
28	24	N. E. S. W.	July, 1853.	August, 1853.	19,671 79	Frac'l Ft Snell. Res'n.
29	24	N. & E.	Oct., 1847.	Nov., 1847.	5,674.58	East of Miss. River.
29	24	N. E. S. W.	July, 1853.	July, Aug., 1853.	16,268.72	West of Miss. River.
115	21	E.	July, 1853.	Sept., 1854.	1,374.75	Frac'l Minn. River.
115	21	N. & W.	Sept., 1854.			
116	21	E.	July, 1853.	Oct., 1854.	8,674.30	Frac'l Bal. 4th P. M.
116	21	N.	Oct., 1853.			
116	21	S. W.	Sept., Nov., 1851.			
117	21	E.	July, 1853.	Nov., 1854.	9,654.96	Frac'l Bal. 4th P. M.
117	21	S.	Oct., 1853.			
117	21	N. & W.	Nov., 1854.			
118	21	S. & E. Frac'l	July, 1853.	Oct., 1855.	13,654.25	Frac'l Bal. 4th P. M.
118	21	N. S. W.	May, 1855.			
119	21	N. S. W.	May, 1855.	July, 1855.	20,274.59	Frac'l Miss. River.
120	21	S. & W.	May, 1855.	July, 1855.	8,371.20	Frac'l Miss. River.
115	22	N. E. W.	Sept. Oct. Nov., 1854.	Oct., 1854.	62.95	Frac'l Minn. River.
116	22	N.	Oct., 1853.	Oct., 1854.	19,769.41	Frac'l Minn. River.
116	22	S. E. W.	Nov., 1854.	Oct. Nov., 1854.		
117	22	S.	Oct., 1853.	Nov., 1854.	21,877.28	
117	22	N. E. W.	Nov., 1854.			
118	22	N. E. S. W.	May, 1855.	August, 1855.	21,487.87	
119	22	N. E. S. W.	May, 1855.	Sept., 1855.	21,639.66	[& Crow Rivers.
120	22	N.	Oct., 1853.	Sept., 1855.	16,823.03	Estimated Frac'l Miss.
120	22	S. E. W.	May, 1855.			[& Crow Rivers.
121	22	S.	Oct., 1853.	Sept., 1855.	202.30	Estimated Frac'l Miss.
121	22	W.	May, 1855.			
117	23	S.	Oct., 1853.	Nov., 1854.	12,312.62	
117	23	N. E. W.	Nov., 1854.			
118	23	N. E. S. W.	May, 1855	July, 1855.	21,599.26	
119	23	N. E. S. W.	May, 1855.	June, July, 1855.	22,980.48	
120	23	S. E. W.	May, 1855.	Oct., 1855.	16,533.32	Est'd Frac'l Crow Riv.
121	23	E.	June, 1855.	July, 1855.	22.00	" " " "
117	24	S. & W.	Oct., 1853.	June, 1855.	18,729.09	
117	24	E.	Dec. 1854.			
117	24	N.	May, 1855.			
118	24	W.	Oct., 1853.	June, 1855.	21,463.03	Est'd Frac'l Crow Riv.
118	24	N. E. S.	May, 1855.			
119	24	N. S. E.	May, 1855.	June, 1855.	13,841.54	Est'd Frac'l Crow Riv.
120	24	E. & S.	May, 1855.	Oct., 1855.	444.50	" " " "

Total surveyed area.....347,928.90 acres.

The following is the area of the unsurveyed portion of the Fort Snelling Reservation, as estimated by Mr. F. E. Snow:

Tp. 27, Range 23..... 760.00 acres.
Tp. 27, Range 24..... 464.44 acres.
Tp. 28, Range 23.....4,334.24 acres.
Tp. 28, Range 24.....1,417.38 acres.

Total.....6,976 06 acres.

Natural Drainage.

Nearly three-fourths of the boundary of this county is formed by rivers. The Mississippi is along the northeast, the Minnesota is along the south and southeast, and Crow river runs along the northwest. It has numerous lakes of clear water, and small

streams that flow from the central or southwestern portions ou ward, in nearly all directions, but no large streams enter t county, except where the Mississippi intersects the city of Minn apolis. Lake Minnetonka is a large and irregular expanse water, in the southwestern part of the county, with high shor and knolls of drift on all sides, navigable for small steamers which there are already five on the lake. The frequency of lak throughout the county is one of its most noticeable features. The are generally surrounded by high drift hills, and have deep water and gravelly shores. Steamers ply on the Mississippi abov the Falls of St. Anthony, and also below, though the rapids belo the Falls, extending about a mile, and the rapids at Meeker's Island about three miles below the Falls, prevent the general navigatio of the river within the limits of the county. The Minnesot river is also navigable throughout its extent in Hennepin county In the north central portion of the county are several extensiv marshes, about the headwaters of some of the streams runnin north, and extending along their valleys.

The Surface Features.

The most of the county has an undulating or rolling drift surface, and a nearly level general contour. The Mississippi river has modified the drift in a wide belt of country along both sides, but especially on the west side, within Hennepin county, making the surface nearly flat, with a lighter, or more sandy soil. This belt of flat land, on the west side, is markedly set off from the rolling portion of the county by a line which nearly coincides, through Dayton, Champlin and Brooklyn, with the supposed boundary line between the St. Peter sandstone and the lower magnesian formation. In the northern part of Crystal Lake this line changes its direction, and approaches rapidly toward the river, entering the corporate limits of the city of Minneapolis in Sec. 16. It then strikes nearly south, running along the west side of Lakes Calhoun and Harriet; then east toward the river, keeping on the east of Lakes Amelia and Mother, after passing which it strikes rapidly toward the west and southwest to Sec. 33, in Richfield township, when it turns nearly south; and in Sec. 16, Bloomington, it coalesces with a similar line which follows the Minnesota river. The belt of land thus set off, is generally flat and often sandy or gravelly with only an occasional knoll of hardpan drift. At some depth below the surface the hardpan drift is uniformly met with in all excavations. This flat tract is, in its widest parts, six miles across from east to west. The narrowest point is in N. Minneapolis where it is less than a mile across. A similar flat belt runs along the east side of the river in Anoka and Ramsey counties. This land is at the present time never reached by even the highest freshet stage of the river. There is *within* the flat tract, along the river, a flood-plain level, subject to annual overflow. If ever the river operated over this belt so as to affect its topography, it must have been at a time when it was of vastly greater volume than at present, and probably during the period of

recession of the ice of the last glacial epoch, and while the material of the drift was itself being deposited. This tract is underlain in some places by a laminated clay, which, when burned for brick, makes the well-known "Milwaukee brick" which are of a light buff or cream color.

The elevation of the county above the ocean is, perhaps on an average, about one thousand feet. The following points have been determined.

Elevations in Hennepin County.

	Above the Ocean.
St. Anthony Junction, St. P. & P. R. R.	829 feet.
Mississippi (low water) at Nicollet Island	791 feet.
Minneapolis Junction, St. P. & P. R. R	821 feet.
Mississippi (low water), half a mile below St. Anthony Falls	711½ feet.
Self's Lake (water), St. P. & P. R. R	842 feet.
Wayzata Station, St. P. & P. R. R	922 feet.
Lake Minnetonka (water)	913 feet.
Long Lake Station, St. P. & P. R. R	940 feet.
Anoka, (opposite Champlin,) St. P. & P. R. R	869 feet.
Minneapolis Depot, M. & St. P. R. R	816 feet.
Minnehaha Creek, (bottom,) M. & St. P. R. R	792 feet.
Minnehaha Creek, grade of M. & St. P. R. R	806 feet.
Minnehaha Station, M. & St. P. R. R	802 feet.
Fort Snelling Station, M. & St. P. R. R	712½ feet.
Bottom of Minnesota river, at crossing of M. & St. P. R. R	663 feet.
Bridge at crossing of Minn. R. at Ft. Snelling, M. & St. P. R. R.	708½ feet.

Elevations on the Minneapolis & St. Louis R. R.

FURNISHED BY COL. J. B. CLOUGH.

[East from Minneapolis.]	Above the Ocean.	
Crossing of St. P. & P. R. R., near St. Anthony Junction	828 feet.	
140 "stations" east of crossing,* (cut of 7 feet,)	938 feet.	Rolling surface.
220 "stations" east of crossing, (cut of 16 feet,)	913 feet	
240 "stations" east of crossing, (track,) Robinson L.	906 feet.	
240 "stations" east of crossing, water surface, Robinson L.	898 feet.	
265 "stations" east of crossing, (cut of 7 feet)	917 feet.	
300 "stations" east of crossing, (track,) Bennett L.	885 feet.	
300 "stations" east of crossing, water surface, Bennett L.	883 feet.	
300 "stations" east of crossing, bottom, Bennett L.	863 feet.	
308 "staitons" east of crossing, clay ridge, (cut 20 feet,)	888 feet.	
320 "stations" east of crossing, track, (cut 18 feet,)	897 feet.	
405 "stations" east of crossing, track at Owassa L.	888 feet.	
405 "stations" east of crossing, bottom Owassa L.	871 feet.	
405 "stations" east of crossing, water surface Owassa L.	878 feet.	
415 "stations" east of crossing, track, (cut 17 feet,)	897 feet.	
Tamarack Swamp, ("no bottom,") track	873 feet.	

[NOTE.—This swamp seems to consist of a mass of floating peat, grass-roots, &c., supporting small tamarack trees. Three piles were driven (spliced), each 60 feet long, making 180 feet, without reaching solid foundation. The track was then supported on a raft consisting of logs, slabs and brush thrown on the surface, and remains so still.]

* One "station" equals one hundred feet.

465 "stations" east of crossing, track	Rolling.	873 feet.
465 "stations" east of crossing, water, (30 ft. piles driven)		869 feet.
600 "stations" east of crossing, track, (ground on either side 30–50 feet higher)		931 feet.
650 "stations" east of crossing, White Bear flats		923 feet.
670 "stations" east of crossing, Junc. of L. S. & M. R. R.		917 feet.
White Bear Lake, (water,) cannot be far from		913 feet.

[NOTE.—The depot at White Bear may be six or ten feet higher than the grade at this Junction.]

[South from Minneapolis.]

Minneapolis & St. Louis Depot, Minneapolis, cor. 2d street and 4th avenue	816 feet.
Crossing of Hennepin avenue, foot of Bridge street, at the old suspension bridge	803 feet.
St. Paul & Pacific Depot, Minneapolis	821 feet.

[The line, to Cedar Lake, follows the valley of Basset's creek.]

Cedar Lake, (track)	855 feet.
Cedar Lake, (water surface)	852 feet.
Bass Lake, (track)	876 feet.
Bass Lake, (water surface)	868 feet.
Divide between Bass Lake and Minnehaha creek	908 feet.
Divide between Bass Lake and Minnehaha creek, (nat. sur.)	920 feet.
Marsh at Minnehaha creek, (track)	885 feet.
Marsh at Minnehaha creek, (surface of marsh)	880 feet.
Crossing of Minnehaha creek, (track)	897 feet.
Crossing of Minnehaha creek, (water)	885 feet.
Divide east of Hopkins Station, (cut 14 feet)	918 feet.
Divide between Hopkins Station and Shady Oak, (cut 18 feet)	901 feet.
Shady Oak Lake, (track)	900 feet.
Shady Oak Lake, (water surface)	898 feet.

[Piles were here driven 78 feet, to a hard bottom, which now support the track; water 20 feet; the rest mud, "or something else." Soundings at first indicated but 20 feet of water; but in filling, the bank settled at least 40 feet further; after two months' work at filling, with little visible progress, the builders had to resort to pile-driving.]

Mud Lake, (track)	893 feet.
Mud Lake, (water)	890 feet.

[Rolling Surface.]

Elevation between Mud Lake and Glen Lake marsh, (cut 8 feet)	913 feet.
Glen Lake marsh, (track)	898 feet.
Glen Lake, (surface of marsh)	895 feet.

[At Glen Lake marsh, after the track was built it sank, and was entirely lost, a lake being formed. Then piles were resorted to, with a depth of 50 feet, for a distance of 250 feet.]

Divide 1,000 feet west of Glen Lake marsh, (cut 18 feet)	908 feet.
Rolling descent to—	
Island Lake, (track)	893 feet.
Island Lake, (water surface)	881 feet.
Divide 1,000 feet west of Island Lake, (track; no cut)	903 feet.

[On the east side of the line hills rise 75 or 100 feet higher, the road running through a gap; on the west side hills rise 30 or 40 feet. At 1,500 feet further south the road passed through a ridge of gravel and red clay (mixed) in which was found a piece of native copper weighing 78 pounds. This was a cut of 30 feet.]

Purgatory creek crossing, (track)	844 feet.
Purgatory creek crossing, (ground)	823 feet.
Purgatory creek crossing, (bottom)	820 feet.

[Piles were driven here 36 feet without finding a hard bottom.]

Eden Prairie Station, (8 feet cut)	873 feet.
Divide between Eden Prairie Station and Lake Bradford, (cut 8 ft.)	891 feet.
Lake Bradford, (track)	868 feet.

Lake Bradford, (water)	855 feet.
Elevation at county line, (Hennepin and Carver; track)	865 feet.
Elevation at county line, Hennepin and Carver, (Nat. Surface)	895 feet.
[At 1,000 feet west of the county line is a cut of 40 feet.]	
Ravine 2,000 feet west of last cut, (track)	836 feet.
[Trestle work is built here 75 feet high, and 450 feet long; stiff clay on the west side of the ravine and sand on the east side. Sudden changes occur in the drift in going down to the Minnesota valley.]	
One mile further on, ravine, (track)	791 feet.
One mile further on, ravine, (bottom)	726 feet.
Foot of the Minnesota river bluffs, near Chaska	742 feet.
[Then comes a quaking, or peaty, marsh for 3,000 feet.]	
Crossing of Hastings and Dakota R. R., Chaska	716 feet.
Carver Station, (12 feet fill)	710 feet.
Minnesota river crossing, (track)	716 feet.
Botton of Minnesota river, (Carver)	678 feet.
Water in Minnesota river, (Carver)	683 feet.
Sioux City Junction	753 feet.

Description of the towns of Hennepin county.

In the following notes on the various towns of the county the magnetic variation given is that recorded by the U. S. Surveyors on the township plats:

TOWNS 27 AND 28, R. 23 W. OF 4TH PRIN. MER. (*Fractional.*) *E. parts of* RICHFIELD *and* MINNEAPOLIS.

These embrace the bluffs of the Mississippi and Minnesota rivers south of Minneapolis, and a narrow strip of level and prairie land along the west side of those rivers above the point of their confluence, not exceeding two miles in width.

T. 29, R. 23 W. OF 4TH PRIN. MER. (*Fractional.*) *E. part of* ST. ANTHONY.

This is a belt of one mile wide embracing six sections, and lies mostly on the east side of the Missitsippi river. It is all included within the prairie land that characterizes the Mississippi valley, except about a mile square in its northern portion, which is rolling and wooded.

T. 27, R. 24 W. OF 4TH PRIN. MER. (*N. of the Minnesota.*) *E. part of* BLOOMINGTON.

By far the larger portion of this town is prairie, lying in the northeastern portion. Along the southern side the bluffs of the Minnesota river are rarely rocky, but usually turfed and frequently timbered. The bottom lands sometimes embrace large water areas, and are very wide, the bluffs running from one-half mile to a mile from the river channel. The timber is generally light, except a small area in the northwest corner of the town. The town has several small lakes in the uplands.

28, R. 24 W. OF 4TH PRIN. MER. *Central part of* RICHFIELD *and northern part of* MINNEAPOLIS.

The central and northern portions of this town are rolling, and ntain numerous lakes, such as Wood, Grass, Mother, Amelia, alhoun, Harriet, Diamond, Pearl, Rice, Duck and Mud. This olling tract is crossed by Brown Creek (now known as Minnehaha Creek). Toward the northeast and southeast are patches of level prairie.

T. 29 N., R. 24 W. OF 6TH PRIN. MER. *E. part of* MINNEAPOLIS.

This town embraces the city of Minneapolis, on both sides of the river, and the Falls of St. Anthony. The largest part of the town is flat, and the southeastern portion contains prairie belts, particularly on the west side of the Mississippi river, within the ancient drift bluffs of the river. The western portions, and a small area in secs. 1 and 12, are rolling and timbered, with lakes. There are also small areas of swamp, the largest being east of the Mississippi river in secs. 12, 13 and 24. Bassett's Creek breaks the surface in the central part of the town on the west side of the river, entering the Mississippi about a mile above the Falls. Mag. var. 9°, 39′ to 11°, 20′.

TOWNS 115 AND 116 N., R. 21 W. OF 5TH PRIN. MER. (*Fract.*) *W. part of* BLOOMINGTON, *and S. W. part of* RICHFIELD.

This embraces a little prairie tract in the southern portion, and several lakes in the northern, but it is mostly undulating and timbered. The Minnesota bluffs bound it on the south, but they are not rocky. They rise about 150 feet above the river. In the northern portion are some high drift-knolls. Anderson lake is the principal body of water. Mag. var. 10° to 12°, 30′.

TOWNS 117 AND 118 N., R. 21 W. 5TH PRIN. MER. (*Fractional.*) CRYSTAL LAKE, *with parts of* MINNEAPOLIS *and* RICHFIELD.

This is entirely a wooded and undulating or rolling tract, running N. and S., about 2½ miles wide, and east to the Mississippi north of Minneapolis. It has small marshy areas, and one irregular patch of prairie northwest of Minneapolis city. Mag. var. 10°, 5′ to 11°, 53′.

T. 119 N., R. 21 W. 5TH PRIN. MER. BROOKLYN.

This town is altogether level, except in the southwest corner, and is mainly one of prairie. The scattered timber is small. Palmer Lake is in Sec. 26, and through it runs Shingle creek, which is accompanied by some marsh. The Mississippi river forms the eastern boundary, but the bluffs are low and consist of drift only. A belt of heavier timber skirts the river in the northeastern portion of the town. Mag. var. 10° 45′ to 12° 39′.

T. 120 N., R. 21 W. 5TH PRIN. MER. *E. part of* CHAMPLIN.

There is a small area lying on the Mississippi river, having a variety of surface, flat prairie, timbered bottom land, and lightly timbered upland.

T. 116 N., R. 22 W. 5TH PRIN. MER. EDEN PRAIRIE.

While this town is mainly rolling or hilly, with lakes and some marshes, and heavily timbered, it took its name from a flat prairie which lies in the southern portion, bordering on the Minnesota river, including the bottom land and a belt about a mile wide north of the bluffs. Mag. var. 10° to 13° 57'.

T. 117 N., R. 22 W. 5TH PRIN. MER. MINNETONKA.

This town is wholly wooded and rolling, some parts being hilly. It also has small areas of marsh, intervening between the drift hills, and occasional lakes, the largest body of water being a part of Minnetonka Lake, from which flows Little Falls creek, (known now as Minnehaha creek,) and crosses the center of the town easterly. Mag. var. 10° 9' to 14° 45.

T. 118 N., R. 22 W. 5TH PRIN. MER. PLYMOUTH.

This is also a rolling and timbered town, with several lakes and tamarack swamps. Medicine Lake in the S. E. corner is the largest body of water. Mag. var. 11° 21' to 14° 45.

T. 119 N., R. 22 W. 5TH PRIN. MER. MAPLE GROVE.

The town is entirely rolling and wooded, except a small portion in sections 1, 12 and 13, which is an extension of the Brooklyn prairie. It is crossed by a small creek running N. through the center, and by its tributary in the N. W. It contains several fine lakes. Mag. var. 9° 45' to 12° 38'.

T. 120 N., R. 22 W. 5TH PRIN. MER. DAYTON, *and W. part of* CHAMPLIN.

This town resembles the last, but borders on the Mississippi river, which has drift-banks that rise about 100 feet above the river. Crow river also touches it on the north. Mag. var. 9° 45 to 12°.

T. 117 N., R. 23 W. 5TH PRIN. MER. EXCELSIOR, *and part of* MEDINA, *and part of* MINNETONKA.

About one-half of this town is covered with water, pertaining to Lake Minnetonka. The rest is rolling and heavily timbered, with occasional marshes. Mag. var. 11° 15' to 13° 12'.

This town is much diversified with lakes, marshes, and a rolling surface. It is entirely wooded. Mag. var. 10° 20′ to 13° 12′.

T. 119 N., R. 23 W. 5TH PRIN. MER. CORCORAN.

A wooded, rolling town, with frequent small marshes and two or three lakes. Mag. var. 10° 40′ to 11° 45′.

T. 120 N., R. 23 W. 5TH PRIN. MER. (*S. of Crow River.*) HASSAN.

This is a wooded, rolling town, similar to the last, but has Crow river along its northern boundary. Mag. var. 9° 13′ to 11° 30′.

T. 117 N., R. 24 W. 5TH PRIN. MER. MINNETRISTA.

This is a rolling timbered town embracing a part of Lake Minnetonka, and several smaller lakes, as well as numerous marshes. Mag. var. 10° 40′ to 13° 12′.

T. 118 N., R. 24 W. 5TH PRIN. MER. INDEPENDENCE.

This is a rolling timbered town, dotted with small marshes and lakes. Mag. var. 10° 5′ to 12° 30′.

T. 119 N., R. 24 W. 5TH PRIN. MER. (*S. of Crow River.*) GREENWOOD.

Crow river, which crosses this town, separates Greenwood from Wright county. It is in every respect similar to those already described. Mag. var. 10° 25′ to 10° 12′.

Soil and Timber.

The most of the county has a close, clay soil of a grayish color. This is particularly the case in the heavily wooded portion. At least three-quarters of the county are embraced under this description. The soil of the eastern quarter of the county is more sandy. The change from clay to sand, while in general taking place along the boundary line already defined under the head *Surface Features*, still is not always abrupt. It is always accompanied by a change of timber species. In the clay land are found sugar maple, elm, bass, butternut, and a variety of others, while in the sandy or loam covered portions are found only oaks and aspens which generally are also quite small. The belt containing this small, sparse timber runs north and south across the eastern portion of the county covering the eastern part of Maple Grove, the eastern part of Plymouth, the western part of Minneapolis and the central portions of Richfield and Bloomington, with isolated areas in Minnetonka and

Eden Prairie. This feature in the forest of the county gradually dies out toward the east, and most noticeably after passing the boundary between the rolling surface and the flat land along the Mississippi; the country becoming nearly a continuous and open prairie. Throughout this belt of sparse and small timber there are occasional large bur oaks on the uplands, and also occasionally gigantic black oaks, with charred trunks, in clusters, having no other company than an undergrowth of oak bushes. There are also, in the bottom land along some of the ravines, occasional trees of elm or bass. The eastern boundary of the heavily timbered rolling area, with a distinctively clay soil, strikes the Mississippi river about three miles southeast of Dayton.

The following species of trees and shrubs are known to grow in the county. The trees are named in the estimated order of abundance:

American Elm. Ulmus Americana, L. (*Pl. Clayt.*) *Willd.*
Bass. Tilia Americana, L.
Sugar Maple. Acer saccharinum. *Wang.*
Red Oak. Quercus rubra. *L.* (?)
Butternut. Juglans cinerea. *L.*
Bur Oak. Quercus macrocarpa. *Michx.*
Red Elm. Ulmus fulva. *Michx.*
Soft Maple. Acer rubrum. *L.*
Bitternut. Carya amara. *Nutt.*
White Ash. Fraxinus Americana. *L.*
Black Oak. Quercus tinctoria. *Bart.* (?)
Ironwood. Ostrya Virginica. *Willd.*
Black Ash. Fraxinus sambucifolia. *Lam.*
Wild Plum. Prunus Americana. *Marsh.*
June-berry. Amelanchier Canadensis. *Var.* Botryapium. *Torr. & Gr.*
American Crab-Apple. Pyrus coronaria. *L.*
Aspen. Populus tremuloides. *Michx.*
Tamarack. Larix Americana. *Michx.*
Box Alder. Negundo aceroides. *Mœnch.*
Great-toothed Poplar. Populus grandidentata. *Michx.*
Black Cherry. Prunus serotina. *Ehr.*
Cottonwood. Populus monilifera. *Ait.*
Water Beech. Carpinus Americana. *Michx.*
Willow. (*Salix.*)
Hackberry. Celtis occidentalis. *L.*
White Birch. Betula alba. *Var.* populifolia. *Spach.* (?)
White Oak. Quercus alba. *L.*
Red Cedar. Juniperus Virginiana. *L.*
White Pine. Pinus Strobus. *L.*

A few trees of white pine occur on Minnehaha creek, and at Dayton.

Shrubs and Woody Vines.

Virginia Creeper. Ampelopsis quinquefolia. *Michx.*
Bittersweet. Celastrus scandens. *L.*
Frost Grape. Vitis cordifolia. *Michx.*
Hazel. Corylus Americana. *Walt.*
Smooth Sumac. Rhus glabra. *L.*
Wild Red Cherry. Prunus Pennsylvanica. *L.*
Wolf-berry. Symphoricarpus occidentalis. *R. Br*
Black-cap Raspberry. Rubus occidentalis. *L.*
High Blackberry. Rubus villosus. *Ait.*
Red Raspberry. Rubus strigosus. *Michx.*

Choke Cherry. Prunus Virginiana. *L.*
Thorn. Cratægus coccinea. *L.*
Rose. Rosa lucida. *Ehr.*
Prickley Ash. Zanthoxylum Americanum. *Mill.*
Staghorn Sumac. Rhus typhina. *L.*
Wild Rose. Rosa blanda. *Ait.*
Round-leaved Cornel. Cornus circinata. *L'Her.*
Common Elder. Sambucus Canadensis. *L.*
High-bush Cranberry. Viburnum Opulus. *L.*
Black Currant. Ribes floridum. *L.*
Alternate-leaved Cornel. Cornus alternifolia. *L.*
Panicled Cornel. Cornus paniculata. *L'Her.*
Red-osier Dogwood. Cornus stolonifera. *Michx.*
Speckled Alder. Alnus incana. *Willd.*
Sheep-berry. Viburnum Lentago. *L.*
Elder. Sambucus pubens. *Michx.*
Honeysuckle. Lonicera parviflora. *Lam.*
Honeysuckle. Lonicera ciliata. *Muhl.*
Yellow Honeysuckle. Lonicera flava. *Sims.*
Kinnikinnick. Cornus sericea. *L.*
Dwarf Cornel. Cornus Canadensis. *L.*
Prickly wild Gooseberry. Ribes Cynosbati. *L.*
Smooth wild Gooseberry. Ribes rotundifolium. *Michx.*
Ninebark. Spiræa opulifolia. *L.*
Meadowsweet. Spiræa salicifolia. *L.*

THE GEOLOGICAL STRUCTURE.

The only rocks seen in actual outcrop within the county are those belonging to the Trenton limestone, and the St. Peter sandstone; but the Shakopee limestone (of the Lower Magnesian formation) is seen in outcrop at Shakopee, on the opposite side of the Minnesota river, and must exist in the immediate bluffs of the Minnesota river in the southwestern portion of the county. It is very likely also that large areas of the Cretaceous formation exist within the county, though its presence is only known by the abundance of Cretaceous *debris* that is found in the drift throughout the county. The geology of the county then may be embraced in the following list of formations:

1. The Drift and the loess loam.
2. The Cretaceous.
3. The Green Shales and Trenton Limestone.
4. The St. Peter Sandstone.
5. The Shakopee Limestone (of the Lower Magnesian.)

The respective areas of the Trenton, St. Peter and Lower Magnesian, are represented on the accompanying colored map of the county, so far as those areas can be ascertained or estimated. It must be borne in mind that there are no outcrops of rock in the county except along the valley of the Mississippi river, and that hence the boundary lines as laid down are not intended to express anything more than an approximation to their actual positions.

The Shakopee Limestone.

The reader is referred to earlier reports for the details of lithol-

ogy and special characters of this limestone. It is sufficient here to say that it is named from the city of Shakopee, in the Minnesota valley, where it was first recognized as a different limestone from that along the bluffs of the Mississippi river below Hastings; and that it is the uppermost member of the *Low. Magnesian* series. It lies just below the sandstone which is seen at the Falls of St. Anthony, and is known as the "Kasota stone" among builders when wrought at Kasota, a few miles above Shakopee, in the Minnesota valley. It is strictly *an arenaceous dolomite* of a buff color varying to pinkish, or "fawn-colored," as described by Featherstonhaugh. Its thickness is about seventy feet. There is no known outcrop of it within the limits of Hennepin county, but it certainly underlies a belt of territory running northward from Shakopee and Bloomington, toward Dayton, through the central part of the county. Were it not for the heavy covering of drift, it might be expected in outcrop about the shores of Minnetonka Lake.

The St. Peter Sandstone—Its Area.

This well known formation is seen in the bluffs of the Mississippi river at and below the Falls of St. Anthony to the mouth of the Minnesota, and exists also in the Minnesota river bluffs for several miles above Fort Snelling; though, for reasons which pertain to the history of the Minnesota river and its age as compared with that of the Mississippi in this vicinity, it is but rarely exposed in the bluffs of that river above Fort Snelling. The slopes from the upland to the river level, along the Minnesota, are uniformly smoothed over by the drift, and are turfed or wooded; but the descent from the upland to the river along the Mississippi, above Fort Snelling, is perpendicular and rocky, the river running in a canon-like gorge. Owing to a dip of the rocks toward the east, the St. Peter sandstone is brought above the level of the Mississippi at points above the Falls of St. Anthony, within the immediate river valley. On the east side of the river it outcrops along Main street, and is struck by digging wells at points further north and east. It underlies a belt of country running north and south across the county, next east of that of the Shakopee, which is probably about six miles wide. In the vicinity of the Falls of St. Anthony the St. Peter is also caused to be the surface rock by the cutting through of the over-lying Lower Trenton by the ancient drainage-courses of the Mississippi, or of its tributaries. Thus there is a break in the continuity of the Trenton where Bassett's creek enters the Mississippi, above the falls. That stream runs at no point over the Trenton limestone, but over the St. Peter sandstone. The valley in which it lies was cut by some more powerful force than the creek itself, and perhaps by the Mississippi river before the last drift epoch. At that time the Mississippi must have reached the Minnesota valley at some point above Fort Snelling, without running over the Trenton limestone at all, and hence without causing any falls. The width of the St. Peter area in the immediate river valley, *above the falls*,

as compared with that in the same valley *below the falls*, considered in connection with the Bassett's-creek St. Peter area, clearly points to the ancient continuation of the Mississippi valley southward by the way of Bassett's creek, to the Minnesota, instead of by way of Fort Snelling. There is another break in the overlying Trenton on the east side of the river, leaving the St. Peter as the surface rock, in a low tract of land in the First Ward, northwest from the Cemetery. This low area is crossed by the Branch Line of the St. Paul & Pacific railroad longitudinally. This area of the St. Peter becomes quite narrow near the St. Anthony Junction, but rapidly widens out toward the south and east, so far as can be judged from the topographical features and from information gathered from dug wells. Just how far this St. Peter area extends south under the extensive peat marsh which covers a large tract in that direction, it is impossible to say ; but the Trenton replaces it, at the surface, within a mile, since it occupies the river bluffs uninterruptedly from Fort Snelling to the Falls of St. Anthony, and since Tuttle's brook passes over it in joining the Mississippi near the University.

Its Lithological Characters.

The outward, and also the chemical, characters of this sandstone, in Minnesota, are, so far as seen, remarkably constant and simple. It is white, "saccharoidal," friable, non-fossiliferous, (or almost so,) and consists almost entirely of pure quartz sand. It contains not enough lime to act as a cement, and hence can almost everywhere be excavated even with the fingers. On exposed surfaces, as along the bluffs of the Mississippi, where dripping water passes over it, the grains become more firmly cemented together by deposition of carbonate of lime and iron oxide, and its delicate whiteness is lost. Indeed, wherever water in the smallest quantity is allowed to trickle through it a deposit of iron oxide is invariably seen, since rarely, if ever, is any surface water found entirely free from that impurity.

The thickness of the St. Peter at the Falls of St. Anthony is 164 feet as developed by a drilled well sunk at E. Minneapolis in 1874-5; but that is considerably more than it is accredited with at points further south. At Chatfield, in Fillmore county, it is 122 feet in thickness, and in the S. W. part of Houston county it is but 75-80.

The St. Peter, operating in conjunction with the overlying Trenton limestone, is the immediate cause of a great many waterfalls. The Falls of St. Anthony are caused by the passage of the Mississippi from the limestone on to the sandstone. The latter, worn away at the foot of the fall by the retro-action of the water, leaves the limestone projecting to fall down in heavy blocks as fast as it becomes too feeble to support further its own weight. This protecting cap of limestone extends but a few rods above the present brink of the falls; and had it not been that vigorous measures were taken a few years since for its protection, it is very probable that ere this the falls themselves would have disappeared,

or changed to a foaming rapid, thus destroying, or greatly damaging, one of the most important water-powers of the world. The first alarm was occasioned by the effect of the water of the river in running through an artificial tunnel in the underlying St. Peter sandstone, and the collapsing of large areas of the limestone. The water was immediately excluded from the tunnel, the sandstone behind the waterfall was protected from the retro-action of the water, and a wall or dike of concrete or *beton* was constructed under the river in the sandrock, and below the limerock, crossing the Mississippi a short distance above the brink of the falls. This wall of concrete has a width of four feet and extends downward from the limerock to below the bottom of the river, below the falls. The chief object of this dike is to cut off all streams of water from running in the St. Peter and so perforating it and eroding it as to cause the downfall of the limerock. A number of such streams, some of considerable size, were found to be passing through the sandrock, having entered it from the river at points above the limit of the limerock. Being under considerable hydrostatic pressure their force of erosion on the sandrock was greater than ordinary surface streams of the same size. One such stream, or sheet, of water was struck by Mr. Franklin Cook, in sinking a drilled well into the sandrock at a point within the gorge some distance below the falls, when the water rose at once above the surface and has continued to flow ever since.

No fossils have been taken from this sandstone in Hennepin county; indeed, the only trace of organic structure known to have been found in it, in the entire northwest, consists of a species of *Lingulepis*, obtained in Fillmore county, and described in the report on that county, in 1875.

The Trenton Limestone.

This formation, as it occurs in Minnesota, comprises three main parts The lowest, only, can be seen generally in Hennepin county, though that next above exists also, and is struck in wells at some distance back from the river. Those parts are—

The Upper Trenton.
The Green Shales.
The Lower Trenton.

The *Green Shales* are often called *soapstone*, but they do not contain the mineral constituents of soapstone, and should not have that name. They are about 20 feet in thickness, but being rather soft and easily covered up, they are hid by the overlying drift or loam at nearly all points along the river bluffs. Within the shales are often thin lenticular layers of very fossiliferous crystalline limestone, the upper and lower surfaces of which are literally covered with fossils in a fine state of preservation, but firmly bound to the limestone layers. There are also fossils distributed through the shales themselves, which, on the weathering of the shales, wash out in perfect preservation. *Orthis Lynx*, *Rhynchonella capax* and *Chaetetes Lycoperdon*, are the most common in

such conditions ; but on the slabs of limestone that weather out of the shales are often a great many minute fossil forms of encrusting corals, as well as other species of brachiopods. The Green Shales may be seen at Finn's Glen, about three miles below the Falls of St. Anthony, on the east side of the river, where a little stream enters the Mississippi.

The *Lower Trenton* is tpyically that which occurs at the Falls of St. Anthony, and thence in the bluffs of the Mississippi to St. Paul. It has generally the following alternation of parts in descending order :

1. Impure limestone.....9–12 feet.
2. Calcareous shale.....4– 6 feet.
3. Argillaceous limestone..... 15 feet.

The above are the main distinctions as seen in Hennepin county. The characters of No. 1 are not always uniformly distributed through the whole thickness designated, but they are apt to fade out downward being replaced by some of the characters of No. 2: which also exhibits a tendency to pass gradually into the rock of No. 3. On the other hand, there is very generally a thin stratum of shale exactly like the most of No. 2, under the limerock, and lying on the St. Peter sandstone.

The following more special section will show the alternations referred to, as they appear at the quarry of E. Malony, on the east side of the river, below the University, at Minneapolis :

Section of the Trenton below the University.

No. 1.—Impure limestone, crystalline, rough to the touch, hard, but splitting to thin lenticular chips under the weather. This is of a blue color within, but on exposed surfaces becomes a dirty buff. The grain is close, except for the cavities resulting from absorbed fossils. The fragments into which the stone weathers out are brittle and somewhat sonorous. It is very fossiliferous especially with *Strophomena deltoidea*. It also has frequently, associated with this, *Strophomena*, a species of *Orthis*, which is perhaps *costalis*, species of *Murchisonia*, *Leperditia*, *Edmondia*, and occasionally of *Asaphus*. Thickness not fully exposed; seen about 8 ft.

No. 2.—Similar to the last, but gradually becoming more impure with shale, the fossils being gathered more into sheets or layers, making mere calcareous belts 2 ft.

No. 3.—Green shale, calcareous, weathering blue, with but few fossils. Occasionally is found a large specimen of *Endoceras magniventrum*, H., in this shale, the form only being preserved, surrounded by a thin black film of bituminous matter.....4 ft. 8 in.

No. 4.—The last passes gradually into a calcareous shale resembling the well-known building rock of this place, in which still there are few distinguishable fossils. This stone is sometimes used for rough walls, or in protected positions. It is markedly set off from the rock below by a projecting shoulder formed by the upper portion of No. 5.....2 ft. 4 in.

No. 5.—The building stone of this place, and St. Paul. This stone is rather too argillaceous to be a reliable building material, yet is extensively used. The shale is intimately disseminated through the calcareous layers, without showing regular lamination, yet causes a mottled or blotched color over the surfaces when cut

or broken. The darker spots are shaly; the lighter ones are more purely calcareous. The color of the whole is blue, which makes it have the appearance of strength and durability when placed in a structure The fossil remains in this member are apt to be comminuted, so as to be wholly undistinguishable, yet sometimes large specimens of *Endoceras magniventrum*, H., are found in the layers. Rarely also, on separating the layers in quarrying, a rock-surface is disclosed that is eminently fossiliferous with forms of *Rhynchonella capax*, *Orthis*, and other brachiopods and incrusting corals. This is the principal and most constant member of the *Lower Trenton*. Thickness about..... 15 ft.

No. 6.—Blue shale, parting conchoidally under the weather, lying on the St. Peter sandstone. Seen..... 2 ft.

Total..... 34 ft.

The section exposed at the quarries on the east side of the river, at Minneapolis, is essentially the same as the foregoing, viz.:

No. 1.—"Gray rock"..... 8 ft.
No. 2.—"Soft stone," (shale)..... 6 ft.
No. 3.—"Blue stone"..... 14 ft.
No. 4.—Slaty clay..... 2 ft.
No. 5.—White sandrock to the river..... 25 ft.

About one block above the railroad bridge over the Mississippi, at Minneapolis, the line of strike of the limerock from the north runs down to the river, but probably crosses the river considerably further down—but a short distance above the Falls. On both sides of the river, above the Falls, the strike diverges from the actual river channel, and passes inland, nearly parallel, however, with the river, and extends some miles northwest; but below the Falls the line of strike is very near the river, and indeed constitutes the bluff of rock which encloses the gorge. The valley occupied by Bassett's creek is wider and deeper cut in the rock than that of the Mississippi below the Falls, as may be seen more clearly by consulting the accompanying map, but the line of strike of the limerock, along the creek, and along the river above the mouth of the creek, is covered by the loam deposit, which is not the case below the Falls to Fort Snelling. Below Fort Snelling the Mississippi bluffs are again covered and masked by the loam. Above the Falls the line of the edge of the limerock forms a terrace ascent facing the river, and about one-half a mile from it, and can be traced by this means on the west side of the river northward to Shingle creek, where it bears westwardly away from the river, along the south side of the creek and becomes lost by reason of the prevalence of the drift; on the east side, at about the same distance from the river, it runs northwardly across the blocks of the Second Ward and diagonally northeastwardly across the blocks of the First Ward, and returns upon itself toward the Junction of the St. Paul & Pacific R. R. Further east another area of the Low. Trenton approaches the river, and its line of strike forms a similar terrace which extends northward to the line of Anoka county and beyond. It is exposed and worked in one or two quarries situated exactly on the Anoka county line, northwest of Sandy Lake, near the railroad. It is evident from its weathered

condition and stained color, although still buried under the loam, that it has been subjected, at this point, and also all along the terrace-like ascent that it forms, on either side of the river, above the falls, to the action of water, and alternating sub-ærial agencies, for a long period of time, and that perhaps it was the water of the river, in times prior to the glacial epoch that stained and shattered it. Indeed it is with some difficulty recognizable, as the same rock that forms the falls at St. Anthony, without a knowledge of its stratigraphical continuity ; this is especially true of the quarries near Sandy Lake on the east side of the river.

There is a gentle dip in the layers of Lower Trenton at Minneapolis toward the southeast. At the lower, or iron, bridge it is very slight, hardly perceptible ; at the falls it is about an inch in one hundred feet ; it increases soon to three or four inches in one hundred feet, and at Central Avenue, on the east side of the river, it is about five feet in one hundred feet. This dip causes the rock to rise from under the river and into the river banks, finally running in the country, as already stated, half a mile or more from the river, and more than fifty feet above it. The dip of five feet in one hundred at Central Avenue is a little away from the river, so that sewers will not empty themselves unless they are run at variance with the dip. It does not continue of the same amount but decreases northwardly, else the layers could not lie at the level they occupy where quarried at points in the north part of the city. This change may be gradual, or there may be a fault, or break, at some point in E. Minneapolis, north of Central Avenue. The St. Peter sandrock is exposed, above the level of the river, above the falls, near the upper bridge, in E. Minneapolis ; and on the west side of the river, at the mill-pond at Shingle creek, two miles north of the limits of the city.

On the west side of the river the strike of the limerock, above the falls, leaves the river-bank about halfway between the railroad bridge and the mouth of Bassett's creek, sweeping round on the south side of the creek so as not to cross it, nor to be visible in its banks. It is quarried in the lumber yard opposite Boom Island, but turns from their rapidly toward the west and south, barely extending north of Sixth Avenue, North. It re-crosses the railroad between Fourth and Fifth streets, and follows the line of the road, but a block or two south of it, to the crossing of Hawthorne Avenue where it turns abruptly to the eastward, and southward along the north side of the lake in the Seventh Ward; but whether it continues in the same direction further than Nicollet Avenue, or bears more to the southward is unknown. The "hardpan" ridge crossing the south end of the Seventh Ward indicates the proximity of the strike of the Lower Trenton along the south side of the same lake, which would require an abrupt change of direction, again to the westward, or the existence of a separate area of Trenton rock lying toward the southwest. On the north side of Bassett's creek is another Trenton area, the eastern edge of which enters the city limits from the north, about one block east of Lyndale Avenue in a southwestward course, crosses Lyndale Avenue between Twenty-third and Twenty-fourth Avenues N.,

passes through blocks 5, 6, 7, and 8 toward the south, and again across Lyndale Avenue between Sixteenth and Seventeenth Avenues N. It crosses Plymouth Avenue two blocks east of Lyndale, and on reaching the valley of the creek it turns westward, but its location cannot be further definitely traced owing to the prevalence of the drift, and the fact that the surface becomes one of a generally rolling character. It is tolerably certain that it does not cross the valley of Bassett's creek, but sweeps round by the west and north and unites with itself along the south side of Shingle creek, about two miles north of the city limits.

The intimate connection which the features and position of the Lower Trenton areas bear to the Post-Tertiary, about the Falls of St. Anthony, has led to a more careful study of history of the drift, and some further allusion to this formation will be found under the head of *The Drift.*

The Cretaceous.

Although the Cretaceous *in situ* has not been seen in Hennepin county, it deserves to be named among the formations of the county on account of the important and conspicuous part it takes in the composition of the drift, and the strong probability that it does exist in horizontal strata below the drift in much of the western portion of the county. There is no portion of the county in which pieces of lignite from the Cretaceous have not been discovered; and throughout the rolling area, where the drift is a close clay, the color of the whole mass is frequently perceptibly tinged with green. Not infrequently pieces of green shale a foot or more in diameter are met with along the cuts by the roadside particularly in the western part of the county—disintegrated and ready to separate on the least disturbance. These of course could not have been far transported by the drift forces. The drift itself is greatly thickened by Cretaceous debris, and *is conspicuously free from foreign stones and boulders of a more enduring nature.* No other Cretaceous debris than pieces of green fissile shale and of black lignite has been recognized, and from these no fossils have been taken.

Seventeen years ago there was some excitement in the vicinity of Dayton over a reported discovery of coal, about two miles west of the village, in Wright county, by a man named Charles Williams. Upon visiting the place, the excavation was found to consist of two shafts sunk in the drift, now nearly refilled. About the place the drift thrown out shows nothing but drift clay with pebbles of all kinds and colors. One is said to have been about eighty feet deep. The general belief now is that all the coal that was found was brought for the purpose from St. Paul, as the owner, after vainly attempting to sell his land, placed a heavy mortgage on it and abandoned the country, allowing the sale of the land for the mortgage. There is certainly now no evidence of the existence of coal, or lignite, in the vicinity, though there are traces of the Cretaceous in the drift which points to the near proximity of its layers. There is also a reported exposure of

NOTES ON THE DEEP WELL DRILLED AT EAST MINNEAPOLIS, MINN., IN 1874—1875.

(*From the Bulletin of the Minnesota Academy of Natural Sciences for* 1875.)

BY N. H. WINCHELL.

	NATURAL SURFACE OF GROUND.			
1	42		Sand.	42
2	28	Blue.	Limestone.	70
3	154	White.	Sandstone.	224
4	102	Red.	Limestone.	326
5	16	Gray.	Limestone	352
6	116	White.	Sandstone	468
7	128	Blue.	Shale.	596
8	82	White.	Sandstone.	678
9	170	Blue.	Shale.	848
10	9	Sandy.	Limestone.	857
11	130	White.	Sandstone.	987
12	∞	Sandy.	Marl.	995
13	79	White.	Sandstone.	1074
14	57	Red.	Marl.	1131
15	290	Red.	Sandstone?	1421

The accompanying diagram of the strata passed through, with the designations of the strata, was furnished by Col. J. B. Clough, City Engineer, in whose charge the work was put by the City Council when money was appropriated to aid the enterprise. This occurred at the depth of about 1,000 feet.

No. 1. This sand is the well-known *loess loam* of the Mississippi bluffs. Though it is represented here as having a thickness of 42 feet, it shows less than one-half that thickness along the river bluff opposite the site of the well, less than 15 rods distant. It is here underlain by a heavy deposit of boulder-clay drift. It is presumable that this boulder-clay, which is itself rather sandy, was penetrated without the knowledge of the workmen, since it is seen to extend as far from the river as the site of the well along Central Avenue and on other streets, and is struck uniformly over the East Division of the city in digging wells at the depth of ten to twenty feet.

No. 2 is the *Lower Trenton Limestone*, embracing some layers of green shale, and is that which causes, in conjunction with the St. Peter sandstone (No. 3,) the Falls of St. Anthony.

No. 3 is known as the *St. Peter Sandstone.* Its thicknes, as here developed, is greater than observed at any other point in Minnesota. It is generally accredited with a thickness of about 125 feet, but here shows 164 feet. It is a purely white sand with very slight cement and very little variation in texture or grain.

No. 4 is known as the *Shakopee Limestone.* It has been placed as the uppermost member of the great Lower Magnesian Formation of Dr. D. D. Owen, but perhaps the St. Peter should be

regarded as the uppermost member of that formation. Its color he appears to be nearly the same as seen at Kasota, where it is large wrought and sold under the name of *Kasota Stone*. Its thickness 102 feet, is greater than has been observed at any other point

No. 5 is designated a *gray limestone*, with a thickness of 16 fee It is a new feature in the lithology of the Lower Magnesian, ar may belong to the Shakopee.

No. 6. Below the *gray limestone* is a white sandstone, simil to the St. Peter above, with a thickness of 116 feet. This can identified as the *Jordan Sandstone*, so named from Jordan villa on the Minnesota river, above Shakopee, where it was first reco nized as a distinct portion of the Lower Magnesian.

No. 7, which is here denominated a *blue shale* having a thic ness of 128 feet, has not before been recognized as a distin portion of the Lower Magnesian. It occupies the place, in ord of stratification, of the St. Lawrence Limestone, but is not thick.

No. 8 is likewise an unknown stratum.

No. 9, in like manner, has never before been discovered. It highly probable that, taken together, Nos. 7, 8, 9 and 10 are t actual equivalents of the St. Lawrence Limestone in point of stra fication, modified in character and increased in thickness by pro imity to the ancient Laurentian belt that lies but few miles furth north. This would indicate the early origin of the Minneso spur of the old Laurentian belt or nucleus of North Americ as a shore line along which shale and sand were accumulated the same time that limestone was being formed at points mo remote in deeper water.

No. 10 pertains to the same horizon, and bears a stronger reser blance to the St. Lawrence.

Nos. 11, 12 and 13 represent the St. Croix Sandstone, but it of less thickness than where seen in the Mississippi bluffs.

No. 14 may represent the "Lingula flags," or the upper portic of the Potsdam Sandstone.

No. 15 was rather clayey to be designated, unqualifiedly, a san stone. It is undoubtedly the upper portion of the great series marls and sands that characterize this horizon in Minnesota, made known by Dr. Owen, and by him and others referred to t age of the Lower Potsdam Sandstone of New York. It seems be the same formation in which the salt well, drilled at Be Plaine, stopped at the depth of 710 feet, though much less co pact than where it is exposed at the surface in southweste Minnesota. It is the same formation as the rock that embrac the well-known "pipestone" or *Catlinite* of Minnesota.

THE UNIVERSITY OF MINNESOTA,
Minneapolis, May 25, 1876.

The Drift.

In Hennepin county this deposit appears under still other featu than those reported from more southern counties, and consi

erable light is thrown on the history of that interesting epoch
geological history. Three important facts respecting it can no
be considered pretty clearly established.

1st. There are two distinct glacial or hardpan deposits in He
nepin county.

2d. The limit of the ice and moving drift of the latter wa
toward the east, not far from the present line of the Mississip
between Minneapolis and Fort Snelling, passing between Minn
apolis and St. Paul.

3d. The Falls of St. Anthony have receded, since the la
glacial epoch, or since the retirement of the lake-like expanse
water that filled the Mississippi valley, reducing the river mo
nearly to its present size, only from the mouth of the Minnesot
at Fort Snelling, a distance of about nine miles.

The facts on which these conclusions are based may be group
under three heads, as follows:

1*st.* *Detailed observations on the composition of the drift.*
2*nd.* *The geographical distribution of the different parts.*
3*rd.* *The gorge below the falls.*

1. *Detailed observations on the composition of the drift in th
vicinity of the Falls of St. Anthony.*

Section 1. *At the Falls of St. Anthony, near the river.*

The drift-bank has been considerably excavated near McAleste
College on the east side of the river for use in the repairs on th
Falls by the United States Engineers. As the point of excavatio
changes, thus successively revealing different parts of the bank
the nature of the whole may be ascertained. A common gener
section is as follows:

No. 1.	Loam	3 ft. to 6 f
No. 2.	Stones and boulders, rounded, sometimes with a considerable thickness of sand	5 ft. to 15
No. 3.	Red hardpan clay, with stones and boulders, lying on the rock	10 ft. to 20

In a few places along this excavation the color of No. 3, is n
so distinctly red or copper-colored. It seems to be lighter, as if
had been mingled with hardpan of a later date which in much
the county is seen to overlie the red hardpan. This shading
color pertains only to the upper portion of the deposit. Th
are also places along the same bank where the light-colored or g
hardpan was deposited in considerable quantities, and still
mains, and as the bank recedes a little from the river this lig
colored hardpan occupies the inner and lower portion of the ma
slope in such a way as to hide the red entirely, and give a fa
impression of its having replaced it. In other places it is seen
lie directly on the red.

By further and more detailed examination of the same be
foregoing No. 2 is seen to become separated into two o

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pretty constant parts. It is sometimes clayey, and of a gray color. It is sometimes entirely made up of gravel and sand with belts of boulders, the alternation of parts being in general expressed by the following:

Section 2. Detailed Section at the Falls of St. Anthony, near the river.

1.	Loam	3 to 6 feet.
2.	2 (a). The gray sand and gravel	0 to 10 feet.
	2 (b). The gray stones and boulders	1 to 10 feet.
	2. The gray hardpan	0 to 6 feet.
3.	3 (a). The red sand and gravel	0 to 10 feet.
	3 (b). The red stones and boulders	1 to 2 feet.
	3. The red hardpan	10 to 25 feet.

There are three main parts or members. No. 1 is never wanting. No. 2 is always seen as far as this excavation is concerned, but its subordinate parts are not always all present. Very often 2 (a) and 2 (b) are the only portions seen; and in other places 2 (a) is wanting, the only thing that separates No. 1 from No. 3 being No. 2 (b). Of No. 3, the red sand and gravel may be absent, but in no case has the line of red stones and boulders been found wanting. The red hardpan, No. 3, is the most conspicuous portion of the whole, and is always present, rising sometimes by alternations with No. 2, (gray hardpan to near the top of the bluff.) There is in that case always a loam (No. 1) overlying, and a similar mixture of red stones and boulders with gray, immediately overlying the red hardpan. The gray hardpan at this point is quite unimportant as a member of the bank, but it is found to embrace very large boulders, not only of granite, but also of the Lower Trenton formation. Its color is very marked in contrast with the red hardpan. The stones in it have the appearance of glaciation. The *red hardpan at this place has not been seen to embrace a piece of the Lower Trenton.* Its boulders are usually small, rarely exceeding ten inches in diameter, while the bulk of it has only stones, less than four inches in diameter, and of a red color and quartzitic composition. "Greenstone" as a boulder is also common in the red hardpan. The iron in it, which causes the color, is *peroxide, non-hydrated.* The iron in the gray hardpan is *hydrated.*

The drift surface on the bluffs along the northeast side of the river, at Minneapolis, shows no gray hardpan. The bluffs rise about one hundred feet, average, higher than the top of the foregoing section and consist, so far as seen, of red clay and gravel. Toward the southeast, where the St. Paul and Pacific R. R. passes out of the valley of the Mississippi, the characters of the gray and red are mingled at first in an overlying stratum of gravel and sand, but before reaching St Paul the gray has entirely disappeared so that in the bluffs at that place the drift is all red clay, or sand, gravel and boulders derived from red clay, the whole having a characteristic prevailing red color. There are places where the shales of the Trenton have stained the drift clay at St. Paul, but those are

low in the valley and near the river. The country generally at St. Paul and thence to Stillwater, on the St. Croix river, fifteen miles east, on the Wisconsin boundary, is everywhere covered only with the red drift. This statement is made without regard to the loam which is found very generally over this portion of the state. Within the valley of the Mississippi at St. Paul the upper portion of the drift is affected by the mingling of gray and red. The following observations, made in St. Paul, belong to this general class of facts.

Section 3. On Sibley street, in St. Paul.

No. 1.	Loam	2 feet.
No. 2.	Stones and gravel, mostly limestone, also boulders, large stones, sloping to the SE. and E	12 feet.
No. 3.	Sand and gravel in beds irregularly alternating with No. 2. Some beds of gravel are two feet thick	10 feet.
No. 4.	Stones and gravel. In this are some northern boulders and limestone pieces, also pieces of green shale; the large stones sloping E. and SE	20 feet.
No. 5.	Red sand, horizontally and somewhat obliquely stratified, often fine and clayey	8 feet.
No. 6.	Red hardpan, seen	12 feet.

No. 6 above is often of the color of common red brick, and is very hard and compact. The stones in it are apt to be small. The upper portion at least shows in some instances a kind of lamination which still holds stones and is very sandy. In other places it passes into No. 5 gradually. But there is a very sudden and marked transition from No. 4 to No. 5, showing plainly a distinct deposit and a different origin. The iron in No. 4, and all above is hydrated, giving the whole a yellowish-gray, or olive cast, but although No. 5 consists of sand, and will admit water as freely as No. 4, it has only the red color of non-hydrated peroxide of iron. Hence the cause given for the color of the iron and of the drift (and generally accepted) as in Ohio, in contrasting the upper and lower portions, is not applicable here. Nos. 2, 3 and 4 make substantially one great deposit, and may come from the disintegration, under glacial water, of the usual clayey drift-sheet in the act of deposition—as the whole locality is in a low spot in St. Paul where the Trenton is broken down by some great drainage force. The boulders and stones in No. 6 are generally of metamorphic rock, there being but very rarely a piece of limestone. What pieces there are of limestone are of some foreign formation not evidently of the Lower Trenton. The stones in No. 4 are nine-tenths of them from the Lower Trenton.

Descending from Sibley street toward Wacouta street, and so toward the general centre of the tributary valley in which these excavations are made, Nos. 2, 3 and 4 gradually taper out and become no thicker than three feet, and other deposits replace them uncomformably thus.

Section 4, between Wacouta and Sibley streets, St. Paul.

No 1.	Loam	2 to 4 feet.
No. 2.	Horizontally stratified yellow clay, varying to blue near the bottom, with no stones nor gravel	2 to 6 feet.
No. 3.	The same as Nos. 2, 3 and 4 of the last section, diminishing in thickness from 25 feet to 2 feet where it runs under the above No. 2, towards the lower portion of the valley	25 ft. to 2 feet.
No. 4.	The same as No. 5 of the last section, red and clayey, showing oblique stratification along the right of the cut, but horizontal along the left; at the extreme right hand passing downward into No. 5—the red hardpan	10 feet.
No. 5.	Stony, red hardpan, seen	5 feet.

No. 2 becomes, at the crossing of Wacouta street, about 16 feet thick, and continues horizontally bedded, but with a gentle, general slope toward the N. E. or toward the centre of the valley. Its lower portion also changes to a quicksand. The gravel and sand of No. 3, of the last section, lie sometimes on No. 5 without the intervention of No. 4. The limestone masses, as well as the granite boulders in No. 3 have their angles rounded and decomposed, some masses even falling to pieces in the process of digging, though this is of course due largely to the quality of the rock. They are all water-worn and stained, rather than glaciated. The limestone masses are generally changed in color through and through, as if having been water-soaked in contact with air, or alternately in contact with air and water, for a great many years. They are not blue and fresh as water-soaked specimens are from a quarry, nor so well preserved as masses seen along the gorge below the Falls of St. Anthony. There are spots below Wacouta street where this member (No. 3) becomes clayey, making a gray stony hardpan, resembling that which covers the western part of Hennepin county, but still very gravelly and stony. This character does not rise above the lowermost two feet, so far as seen in the excavations on Wacouta and Sibley streets. Below Wacouta street the thick clay (No. 2 of the last section) is seen lying *below* a layer of stones and gravel, and this position can be traced in the opposite bank to some distance above Wacouta street, the clay gradually becoming thinner till it allows the overlying gravel and stones to come into contact with those of No. 3, the only remaining difference between the upper and lower parts being then a difference in *throw*, or slope, of the larger stones, as noted in *Section* 3. It is supposed to be the equivalent of the brick-clay at Minneapolis, at Lake Minnetonka and at Carver, though it does not everywhere make brick of the same color. It lies directly on the gravel and stones of No. 3, with a sudden transition, indicating some great and sudden change in the force depositing the material, followed again by a revival of the former drainage force, giving origin to the overlying course of stones and gravel. It is wholly embraced within the period of deposit of the gray or later drift.

The exposures within the Mississippi valley at St. Paul may be summarized in a general way as follows:

Section No. 5. Summarized section of the drift within the valley at St. Paul.

1.	Loam	3 to 10 feet.
2.	2 (a). Gray sand, gravel and stones	0 to 10 feet.
	2 (b). Fine, laminated blue brick-clay	0 to 16 feet.
	2 (c). Gray sand, gravel and stones	20 feet.
	2. Gray hardpan	2 feet.
3.	3 (a). Fine, laminated red sand or clay, the *Tripoli* of Stillwater	0 to 10 feet.
	3 (b). Red hardpan	10 to 20 feet.

Outside of the valley of the Mississippi near St. Paul, and within the limits of the city, the general aspect of the drift is red, particularly toward the east, the red hardpan, or its product, the red sand and gravel, rising to the tops of the bluffs, the foregoing No. 2, of the general section, being absent. The red hardpan is sometimes locally modified, and is largely converted by wash and drainage to a coarse sand, as seen in the cuts near the St. Paul and Pacific Junction with the West Wisconsin Railroad. Along the north bluffs of the river this character prevails, overlain by a thickness, usually not great, of No. 1.

At three-quarters of a mile below the University the drift at the rim bank consists as follows:

Section 6. Three-quarters of a mile below the University.

1.	Loam	5 feet.
2.	Gravel and gravelly clay	20 feet.
3.	Red hardpan to the rock, perhaps	15 feet.

At Minneapolis, near the west end of the lower bridge, the drift consists apparently of gray hardpan, 7 feet, without any trace of the older red drift. The same is true at the stone quarries about a quarter of a mile further S. E.—thus in more detail at the quarries.

Section 7. At Bank's Arenson's quarry, Minneapolis.

1.	Loam	3 feet.
2.	Gravel and stones, the latter being mostly granitic, but with a few pieces of limestone, varying to	12 feet.
3.	Stony, gray hardpan clay	

Section 8. Corner of Washington avenue and Sixth avenue, north, Minneapolis.

1.	Loam, stratification not evident; apparently passing downward into brick-clay	2 to 4 feet.
2.	Brick-clay	1 to 4 feet.
3.	Fine sand, lying unconformably under the last	1 to 4 feet.

No. 1 contains calcareous concretions as large as peas and walnuts. It cannot be said to merge certainly into No. 2, but it seems to. The stratification of No. 2 fades out gradually upward, while the texture and composition continue somewhat into No. 1, becoming also yellow, or at last rich brown or black when it is termed soil. No. 2, as seen in this exposure, consists of a long synclinal, the axis running nearly north and south, toward the west, so lifted as to disclose what it lies on, (No. 3.) It is quite calcareous, showing concretionary lumps, and coatings, and also at a point on Fifth street, fresh water species of shells—though the cut there may be more nearly the equivalent of No. 1. This section shows that the source of the water which spread the brick clay was toward the west, and that the bottom on which it was spread was one of stratified fine sand which increased toward the west. This is near the descent to Bassett's creek, and over the St. Peter sandstone, (the Trenton having been broken down,) and that stream or its valley, had something to do, probably, with the sudden transition seen here from sand to brick clay. Although there is at one point in this cut an agreement in direction between the strata of the sand and those of the clay, yet on close inspection it appears that the clay came on suddenly.

At the yard of the *Union Brick Company* (Baxter, Woodward and M'Nair) the clay is yellow, with some beds of fine white sand to the depth of about eight feet, when it begins to show blue. Upward here it becomes a clayey loam. The strata have a wavy outline, synclinals and anticlinals following each other twice in about 14 rods, rising and falling six feet.

At Woodbury's brickyard, which is about half a mile west of the Union Brick Company's, within the valley of Bassett's creek, the clay is underlain by a quicksand which furnishes water that rises to within twelve feet of the surface. The clay is about forty feet in thickness and contains thin layers of sand, interlaminated, which becomes white on drying. The upper portion gradually becomes yellowish by exposure and the hydration of the iron, the lower portion being blue. There are also in it calcareous concretions and a few large *Unio* shells which are very fragile. This clay seems to occupy the valley of Bassett's creek generally. At the Sumner School house, which is in the valley of this creek, north of Woodbury's yard, after drilling through this clay, over 100 feet, an artesian overflow of water was obtained.

Passing across Bassett's creek, on Western avenue, and ascending the bluffs on the west side of the creek, the drift is found to consist of the red gravelly hardpan, covered by a light loamy soil. The surface is rolling, with frequent springs and numerous lakes.

At Richfield P. O., Minnehaha creek runs about 35 feet below the general level of the country, and the banks are composed of gravelly, gray or yellow clay. No red clay can be seen. But at the school house in Richfield, Sec 18, on Minnehaha creek, the well, dug, disclosed the red drift clay some feet below the surface. At the Edina Mills there is a bank of drift, composed of clay and gravel of the usual gray color, containing many pieces of the Trenton limestone.

On the NW. ¼ of Sec. 8 (S.) Crystal Lake, a cut in the Osseo road shows the gray and red hardpan as follows:

Section 9. *NW.* ¼ *Sec.* 8 (*S.*) *Crystal Lake.*

1. Gray or yellowish hardpan, with few Cretaceous pieces, and some boulders..... 8 feet.
2. Red hardpan passing into red sand and gravel below..... 6 feet.

The red passes into the yellow by a series of blotches interchanging one with the other, as if coarsely mixed. Even between the blotches there is a sudden change of color. When the line of union is not broken up into blotches the change of color is abrupt. The late, or gray hardpan is more calcareous than the older. The appearance of the red drift is, as if there had been a lake, or at least a low spot in it, prior to the deposition of the gray.

In Sec. 16, Eden Prairie, a cut by the road shows the red drift, on a low level, but five or six feet above the creek, while in the higher portions the gray only is seen.

Near the mill at Minnetonka City the old red drift can be seen in a little excavation by the road, on a level with and near the creek. It is overlain by a course of stones and gravel, in which appears a piece of the Trenton, and that again by the great deposit of the gray hardpan generally over the country.

The drift knolls at Wayzata are of the brown hardpan, but occasionally show the red at low levels where cut by the roads.

About the west end of Lake Minnetonka the drift is very clayey and has a great proportion of Cretaceous materials. The water of wells is very hard.

The ridge which enters the corporate limits of Minneapolis (Sec. 27) is a spur from the main drift-bluff running along the west side of the river. The most of it, within the limits of the city, is of gray hardpan and gravel, with variations toward the west and northwest toward the red hardpan, of which there is a considerable area extending to and beyond Cedar Lake.

Sec. 36, Champlin. The rolling land begins gradually, the timber changing also gradually. The rolling land is stony, clayey or gravelly, with patches of sand as revealed in wells, and some places of stratified clays near the flat country. The stones are mostly granitic, but have among them, also, numerous large masses of light-colored, fine-grained dolomite, which are burned for quick-lime. The ridges are said to run generally S. W. and N. E., but are very irregular, with depressions and cross-ridges. Water is easily got in wells at about 40 feet—sometimes in 15 or 20.

At the mouth of Elm creek, near Champlin, the bank is exposed by a recent wash, disclosing the composition of the plain on which are Osseo and Brooklyn. The upper portion of the bank, including the loam, is 18 feet, and consists of coarse sand, with gravel and pebbles obliquely stratified, the whole of a light brown color. The lower portion—25 feet—consists of red hardpan which continues down to the level of the water of the Mississippi.

In traveling the river road from Champlin to Dayton, a very noticeable change occurs in the nature of the surface drift, before

reaching the latter place. It becomes lighter colored, shaly or ashy, with pieces of slate. About a mile below Dayton a large freshet wash by the roadside, where a creek enters the Mississippi river, shows an exposure of about 35 feet of pebbly clay of a light, gray color, with pieces of slate, and an occasional boulder near the bottom, underlain by a sand of the same color, 20 feet thick, varying to very fine or clayey, stratified, which, washing out easily, causes the downthrow of large masses of the clay, both in the creek gorge and along the river bluff. No red drift is visible. The surface about is rolling, with occasional boulders.

At Dayton the general character of the surface is of the gray, or ashen, slaty, rolling hardpan. Along the bank of Crow river the drift is exposed in a good section.

Section 10. *At Dayton.*

1.	Stratified fine sand and clay	10 feet.
2.	Blue drift hardpan	25 to 30 feet.
3.	Red drift hardpan	8 to 10 feet.

In No. 2 are many fragments of Cretaceous slate, sidorite, iron concretions, (covered with gravel and cemented by iron rust,) granitic pebbles, and (Devonian?) limestone masses which have supplied a great deal of quick-lime, and an occasional large granite boulder. In No. 3 are a great many small greenstone and quartzite stones, and but few that are large, also many granitic stones. Along the bank of the river a piece of native copper about the size of a hickory-nut was found by James Ream.

At the old bridge on Sec. 18, Hassan, or a few rods below it, on the right bank of Crow river, is a deposit of coarse crag, three feet thick, comprising the pebbles and stones that were washed out of the old red hardpan. It dips a little to the east, and shows as a persistent layer for 30 or 40 rods, causing a terrace in the surface of the alluvium of the flood plain, and rising, at the bridge, about 18 feet above the river, beyond which it seems to strike inland and is lost. It also appears on the opposite side of the river above the bridge. In the opposite direction it finally runs down to the level of the river, eastward, and disappears. It has been used by Mr. Hoag for underpinning for his house.

About the lakes (Mother, Amelia, Calhoun, &c.,) the country is rolling, but is less so toward the southeast part of that tract; indeed the rolling area gradually dies away into the plain in some parts of Richfield so that its eastern margin is not so marked. On the plain the soil and the subsoil is gravelly or sandy, very rarely stony. The same is true of the rolling tract about Diamond Lake. There are no stones in the fields nor about the lake shores. This seems to indicate the agency of water rather than of ice in piling up these outer knolls, and in spreading the gravel of the plain. Minnehaha creek has a gravelly bottom all the way below Richfield, at least.

Through sections 20 and 19, in the southern part of Bloomington, the hardpan drift, on the north side of the Ferry road, rises above the flat on which the road runs, with the appearance of a

terrace, and is wooded with oaks, aspens and ironwood. For some distance the terrace-like level on the surface of the hardpan is about half a mile north of the road, and rises about 40 or 50 feet. It is stony with occasional boulders, becoming more rolling further north.

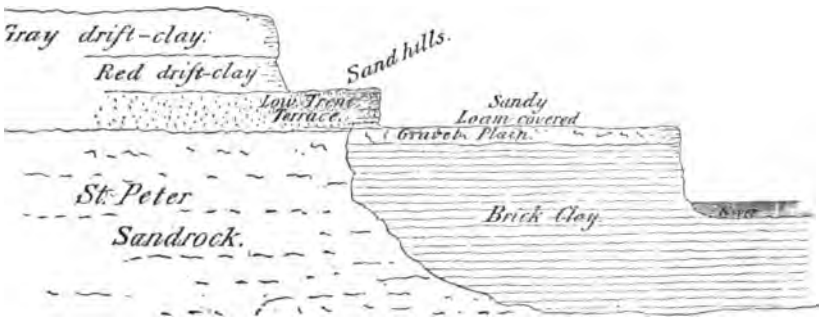
At Bloomington Ferry the river runs near to the hardpan bank on the north side. The bank rises 140 feet above the water in summer. This is about the average, the top of the hardpan being of irregular outline. This includes the "terrace" of hardpan mentioned in sections 20 and 19. That terrace appears to approach the river here. The surface farther back is still higher, and indeed continues to ascend with an irregular contour. The hardpan is yellowish brown or gray, and gravelly near the top, but also has afforded some large granite boulders, that now lie in the street near the ferry, and others that are on the beach below the ferry. The Minneapolis and Chaska brick-clay is seen also at the ferry, and some years ago supplied a red brick seen in the house of Mr. Chadwick. Within a mile and a half, toward Eden Prairie, the surface rises apparently about 100 feet higher.

The well of Mr. J. Miller, N. W. ¼ sec. 9, Crystal Lake, was dug March, 1875, by Mr. J. G. Sommers, who gives the following section:

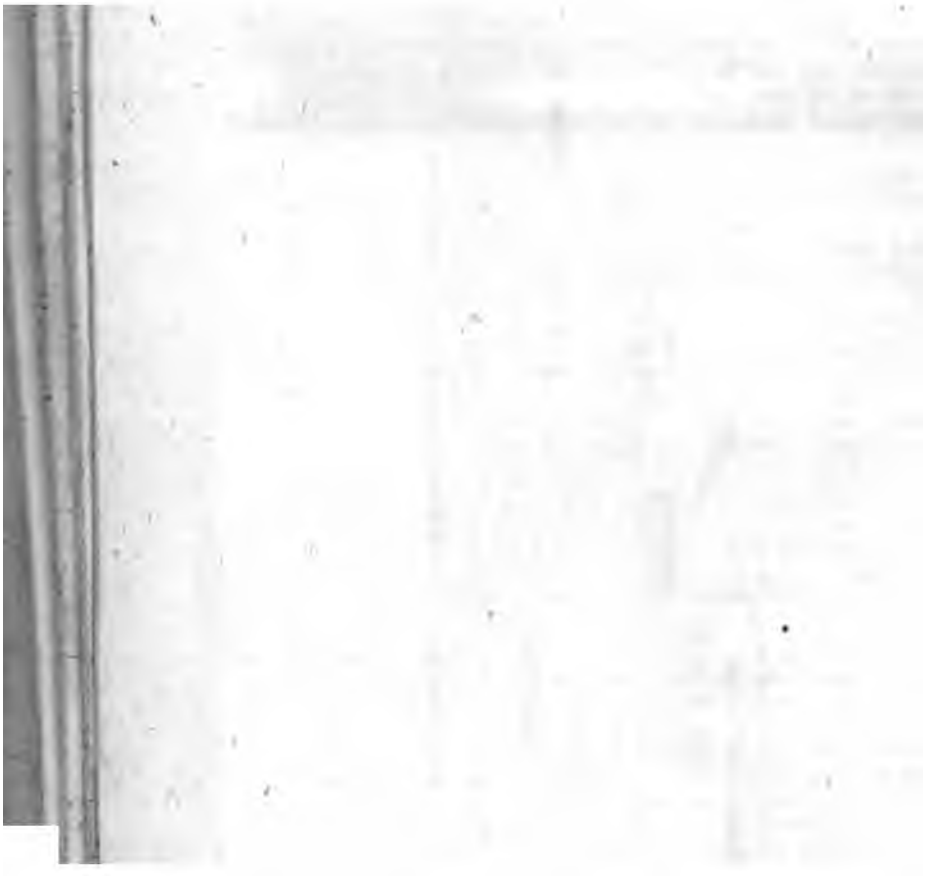
Section 11. *N. W. ¼ Sec.* 9, *Crystal Lake.*

1.	Loam	1 foot.
2.	Yellow hardpan, with little stones	5 to 6 feet.
3.	"Blue black clay" with no stones nor bedding; "one solid mass." This had sticks at different depths, and small pieces of Cretaceous coal, but positively no stones. Small quantities of water were met at 15 feet below the surface, and again at 25 feet	45 feet.
4.	Sand, boulders and gravel, all mixed; clean, with no clay. Some of the boulders being very large	3 feet.
5.	Light clay (even lighter than No. 2) with small stones but no boulders; nothing red about it	19 feet.
6.	Mixed stones and gravel; cemented	1 foot.
7.	Sand with water	2 feet.
8.	Blue limerock; rough, not polished nor scratched; depth of well	76 feet.

At Charles Grotjann's old brickyard, in Upper St. Anthony, the clay contains lumps and concretions of clay, and also the usual limy concretions. The most interesting feature at this point is the jamming and folding to which this otherwise regularly laminated brick-clay has been subjected. There is a thrust-up place near the river, at the brickyard, which shows these laminations crumpled and broken, with a sudden transition upward into gravel and sand, which is unconformably stratified. This might possibly have been done by floating ice in the river at some earlier stage of the valley when the river may have covered this level which is 15 or 18 feet higher than the usual freshet rise of the water. Yet it hardly seems attributable to that cause, since it is not only covered with the loam, which is referable to that last high stage, in undisturbed continuity, but is so deeply within the bank that



Section of the right bank of the Mississippi near the mouth of Shingle Creek.



crowding ice could hardly reach it. The terrace flat of Upper St. Anthony, underlain by the brick-clay, is 25 feet higher than the river.

The highest drift knolls in the neighborhood of Minneapolis are in Anoka county, about Sec. 24 Manomin, in the neighborhood of Sullivan's and Moore's lakes, but east of them. They are of red drift clay, with gravel and granitic boulders, yet *the boulders are not so common* as might be expected from the fact that these areas suffered the exposure and surface drainage incident to the last glacial epoch. The soil is clayey, and loamy, but between the bluffs and the river are extensive sandy flats. Little wet spots, even lakes and swales which never become dry, lie between these knolls. These hills continue SE. toward Bower's Lake in Ramsey county. The high hill north of and near Bower's Lake is 130 feet higher than the NE. corner of Moulton's Nursery, which may be taken as an average height for the hardpan drift bluffs along the east side of the river. From the Nursery to the foundation of the University is a further descent of 110 feet; thence to the river at the University 137 feet, making a total descent from the high knolls at Bower's to the river below the falls, in the rapids near the University, of 377 feet.

On section 12, Crystal Lake, near the mouth of Shingle creek, in digging a well for Mr. J. Kesler, Mr. O. E. Spear found a stick as large as his wrist in a blue clay, (the brick-clay) that had no stones nor gravel, about 18 feet beneath the surface.

On the N. E. ¼ sec. 12, Crystal Lake, at Peterson and Swansen's brickyard, this same clay is manufactured into cream colored brick. It is obtained in the immediate river-bank, and runs apparently beneath the river. It is blue, stoneless and horizontally stratified.

Section 13. *N. E.* ¼ *Sec.* 12, *Crystal Lake, at Peterson and Swansen's Brickyard.*

1.	Loam	3 feet.
2.	Sand, gravel and pebbles; stratified; sometimes rusty	4 to 6 feet.
3.	Brick-clay; blue; horizontally bedded	15 feet.
4.	Slope to the river; apparently clay	15 feet.

An ideal section of the right bank of the river at this place, (near the mouth of Shingle creek,) would be as shown by the following diagram. This is based on the observed exposures of the various parts in such topographical positions as indicate its correctness:

The above figure represents the brick-clay as lying immediately on the St. Peter sandstone, because at that point no drift-clay can be seen to lie between them. It is more probable, however, that a deposit of drift-clay, perhaps both the red and the gray, runs below the brick-clay, as seen at St. Paul; or at least that such a deposit ante-dated the brick-clay, though sudsequently perhaps entirely swept away.

Further information concerning the drift was sought for in developments of the common wells throughout the country. The following table shows the result:

Owner's Name.	Location.	Feet in the drift.	Feet in the rock.	Total Depth.
N. O. Phillips	NW. ¼ Sec. 6, St. Anthony	20	..	20
D. D. Moore	SE. ¼ Sec. 6, St. Anthony	40	..	40
D. D. Moore	" "	40	..	40
Frank Thery	" "	87½	..	87½
—— Wilson	Hoyt's Addition to St. Anthony	15	..	15
Crystal Lake House	Sec. 10, Crystal Lake	30	..	30
Jesse N. Richardson	Richfield P. O.	68	..	68
—— Rankin	Eden Prairie Station	43	..	43
John Brown	Near Bloomington Ferry	88	..	88
John Scofield	Four or five miles E. of Bloomington Ferry.	53	..	53
—— Marville		75	..	75
—— Clark	¼ mile N. of Highland Park	52	16	68
N. Palmer	Gale's 2nd Addition, Minneapolis	26	19	45
Fred Wagner	No. 1200 N. 23rd St., Minneapolis	25	19	44
—— Bailiff	4 miles E. of Bloomington Ferry	56	..	56
Wm. Knight	SE. ¼ Sec. 10 Crystal Lake	14	..	14
C. H. Sanborn	NW. ¼ Sec. 5, Crystal Lake	40	..	40
All wells in	Osseo, and Brooklyn generally	12–14	..	12–14
Wm. Schmidt	Sec. 36, Champlin	45	..	45
Mathias Zopli	Sec. 36, Champlin	20	..	20
Ferdinand Schmidt	Sec. 1, Maple Grove	44	..	44
Fonduck House	Champlin	33	.	33
Wells at	Champlin, generally	25–33	..	25–33
—— DePuy	Sec. 12, Hassan	17	..	17
Peter Hill	SW. ¼ Sec. 4, Minneapolis	22	.	22
David Corban	NE. ¼ Sec. 12	70	..	70
Joseph Mennesey	SW. ¼ Sec. 29, Maple Grove	16	..	16
Thomas Hennesey	" "	15	..	15
Martin Devery	SW. ¼ Sec. 28, Maple Grove	65	..	65
Wells generally at	Maple Grove	15–25	..	15–25
Crystal Lake House	SE. ¼ Sec. 6, Crystal Lake	40	..	40

's Name.	Location.	Feet in the drift.	Feet in the rock.	Total Depth.
l.....	SW. ¼ Sec. 31, Richfield (E).....	75	..	75
l.....	" "	27	..	27
l.....	" "	53	..	53
chou.....	NW. ¼ Sec. 31, Richfield.....	53	11	46
sseau.....	Sec. 14 Bloomington.....	27	..	27
d.....	NW. ¼ Sec. 14, Richfield.....	56	..	56
.....	Sec 5, Bloomington	56	..	56
.....	Long Lake.....	14	..	14
.....	Long Lake.....	60	..	60
lls.....	Long Lake.....	175	..	175
t.....	Sec. 23, Minnetrista.....	25	..	25
eh.....	St. Bonifacius, Minnetrista.....	36	..	36
.....	" "	36	..	36
.....	NW. ¼ Sec. 9, (S.) Crystal Lake.....	56	20	76
.....	Highland Park, Minneapolis.....	27	..	27
egley.....	19th St., bet. 20th and 21st Aves., N.....	45	..	45
ey.....	19th St., bet. 20th and 21st Aves., N.....	37	8	45
.....	Cor. 20th St., and 21st Ave., N.....	20	25	45
ter.....	Christmas Ave. and 23rd St.....	39	9	48
er.....	NE. ¼ Sec. 8 (SE.) Crystal Lake.....	?	..	?

2. *Geographical distribution of the different parts.*

(a). *The red hardpan.*

This, which from its position must be regarded the oldest of the different parts, is found exclusively in the eastern part of the county, and thence eastwardly to St. Paul, and through Washington county to Stillwater. It seems to be the principal deposit, rising from immediate contact with the indurated rocks to the surface of the country. It is locally modified by the loss of its clay, so as to consist almost entirely of coarse sand and gravel, or, in other places, of stones and boulders. Along the main valleys, as at St. Paul and at Stillwater, its upper portion, to the thickness sometimes of twenty feet, consists of very fine clay, which yet seems to contain a large per cent. of silica, (nearly 75 per cent. according to Prof. Peckham,) the whole derived doubtless from the gentle washing of the red hardpan. This fine red clay has been referred to in a former report as possibly pertaining to the Cretaceous. Its color is due to non-hydrated ferric oxide. The red hardpan also appears on the west side of the river at the surface of the drift, and constituting its principal mass, in the western part of the township of Minneapolis, in the rolling tract that embraces lakes Calhoun and Cedar; also northwardly to Bassett's creek; also, with some modifications in much of the townships of Richfield, Eden Prairie and Minnetonka. As a loam covers much of this part of the county it is not possible to define the exact limit of its distribution. There is a rolling belt of small timber, (oaks and aspens,) that extends north and south across this part of the county, which seems nearly to coincide with the superficies of the old red drift clay on the west side of the river. In general that is the timber that characterizes it on the east side of the river. Even within this area on the west side of the river there are spots where the color of the hardpan is modified toward the gray color; and other places where there are important deposits of gray hardpan overlying the red. This is particularly the case in the northern part of Minneapolis, and in Crystal Lake townships, covering the locality at which the Mississippi seems to have been deflected from its old channel. The extensive flat in eastern Minneapolis, Richfield and Bloomington townships is also underlain by this red hardpan, but it is also supplied with extensive superimposed gravel deposits, as well as with patches of unmodified gray hardpan. The gray hardpan may be seen in the immediate bluffs of the river in some cases, both on the west and on the east sides, within the limits of the city of Minneapolis, but the red is found to lie nearly everywhere, under this flat as the lowest portion of the drift. The red extends under the gray hardpan an unknown distance westward. It is seen in deep valleys and excavations along the central portions of the county, but with decreasing frequency toward the west and northwest, until nothing is known of it, at least within the limits of Hennepin county.

(b) *The Gray Hardpan.*

This covers the greater part of the county, gradually becoming thinner toward the east and southeast. Within the valley of the Mississippi it extends at least to St. Paul, found in the depressions between the rock bluffs, or in the lower depressions in the old drift-surface. In those areas, however, not embraced within the river valley, nothing has been seen of the gray hardpan as far east as St. Paul. The gray hardpan, or the gravel, sand and stones that result from its modification, seems to be spread generally over the upper flats and terraces that exist, from different causes, along the river below the Falls of St. Anthony. It begins to be mingled with the red drift, and finally to cover it entirely, within the limits of Minneapolis. The conspicuous ridge of hardpan within the city, (sec. 27,) is of a gray color, but it blends with the main river bluffs toward the northwest, along the west side of Bassett's creek, and loses its distinctive characters. The gray color, however, prevails on the north and east side of the creek, through a rolling tract of country, and into Crystal Lake township—and thence, uninterruptedly, northwestwardly. The gray hardpan surface is specially characterized by heavy timber, particularly after passing out of the valley of the Mississippi, and thus beyond the area liable to its modified conditions. It is observable that the eastern line of the Big Woods, properly so-called, (i. e. comprising large trees of Sugar Maple, Bitternuts, Elm, Bass, Oaks, &c.,) nearly coincides with the eastern line of the unmodified gray hardpan, and approaches the Mississippi river at Champlin, actually reaching the river bluffs a few miles below Dayton. This line may be said to run, in general, from the eastern end of Lake Minnetonka to Champlin. Whatever gray hardpan is found to the east of that line, or to the southeast, speaking generally, seems to have been mingled with the red, and to have lost much of its clay. It is hence often converted to a gray gravel and sand, and is in many places replaced by red hardpan or by red gravel and sand. A gray gravel which varies to a hardpan, is spread out over the flat on which Minneapolis stands. This is covered by the loam, and is underlain by the red hardpan.

(c) *The Brick-Clay.*

This is found particularly within the valley of Bassett's creek, and, above its mouth, in the valley of the Mississippi. It very rarely rises above the level of the top of the Trenton terrace, but has a thickness, as shown by the well sunk at the Sumner School house, of over 100 feet in some places. A similar clay, supposed to be of cotemporaneous origin, is seen embraced between deposits of gravel and boulders, at St. Paul, as shown by the general section at that place, and lying above the gray hardpan. A similar stratified clay is found at Lake Minnetonka, and at Carver, in the valley of the Minnesota.

The general distribution of these parts, in the vicinity of Minneapolis, is shown by the accompanying map, but a great many details, and exceptions are disregarded.

At Banks Arenson's quarry, on the west side of the river, nearly opposite the State University, the gray hardpan, which is stripped off the rock for quarrying, lies over a glaciated rock-surface, the marks running N. NW. and S. SE. While these marks correspond with the general direction of the river at this point, their regularity and persistence over a large surface preclude their having been caused by the action of the water of the river. The quarry has also been worked back from the line of the strike of the bluffs, and this stripping is about four rods back from the old line. The marks are also immediately overlain by a stony hardpan which is of the last glacial epoch, being olive-colored or earthy, not red like that which lies on the rock generally on the east side of the river.

Glacial striæ on Hennepin Island, above the paper-mill, run 32° West of North, by compass.

When the rock-surface was exposed for the City Market, it was not striated, but polished and scratched promiscuously.

The rock-surface is said to be glaciated on Nicollet Island, but no opportunity has been afforded of taking the direction.

According to Col. J. B. Clough, of Minneapolis, a piece of native copper weighing 70 pounds was taken from the drift in a R. R. cut, on the Minneapolis and St. Louis R. R., about 13 miles S. W. of Minneapolis, in 1872.

A piece weighing about two pounds was found in the fall of 1874, in grading the streets of Minneapolis.

Mr. W. D. Hurlbut has also found several pieces in the drift near Rochester, in Olmsted county.

3. *The Gorge below the Falls.*

From the Falls to Fort Snelling the gorge between the rock bluffs is about a quarter of a mile in width, and the rock has a freshly-broken appearance, the large fragments thrown down by the action of the water, as the falls receded, still existing in the talus along the bluffs. Throughout this distance (nine miles) the rocks lie horizontal, hence the recession, so far as it depends on that element, has been of uniform rate. The hight of the bluff above the river remains also nearly the same throughout this entire distance, increasing a little perhaps near Fort Snelling. The relative length of time during which the rocks of this gorge have been exposed to atmospheric forces, compared to that of the bluffs below Fort Snelling, or to that in the ancient valley now occupied by Bassett's creek, is indicated by the depth to which they have been weathered or stained. It is well known that the same rock may present different colors from the effect of atmospheric agents. The Lower Trenton, for instance, is blue within, when freshly quarried at fresh exposures. That is the color it has in all the quarries below the falls at Minneapolis, and which it shows in deep quarrying at St. Paul. This color is met with either immediately at the surface, as at the Falls, or within an inch or two of the surface as at Fort Snelling. When weathered long, the stained coating becomes thickened. The stone then is

either rusty-buff, or yellowish and dirty, resulting from the oxydation and hydration of the iron which it contains. This color may penetrate to the depth of several feet, depending on the porosity of the rock, and the length of exposure. At quarries above the falls of St. Anthony, near the mouth of Bassett's creek, this stained condition is found to penetrate the whole Lower Trenton, the rock at the same time having become more easily separable along some of its bedding planes, and also more firmly cemented by the permeation of the iron through the more shaly parts. The same change is visible in the old river bluffs above the falls where the Lower Trenton is wrought on the east side of the Mississippi, opposite the mouth of Shingle creek, and to a considerable extent in the quarries in Upper St. Anthony.

The gorge below Fort Snelling, where the Minnesota and the Mississippi unite, is about a mile wide, between the rock-bluffs; and the Minnesota above Fort Snelling has the same width between the rock-bluffs. Besides the aspect of greater age, as indicated by the greater change of color in the rock below Fort Snelling, the bluffs themselves are smoothed and the rock hid by drift and loam since the action of the river ceased. The top of the rock along the gorge above the fort is surmounted with a thickness of drift gravel and clay, which shows a section, as cut by the river, continuous, perpendicularly, with the rock-bluff itself. This thickness of drift is nearly uniform from the Fort to the Falls, and indicates the spreading of the drift before the recession of the Falls; but below Fort Snelling (with a single exception, to be noted,) the rock-bluff is generally hid by a subsequent accumulation of drift. The same is true of the bluffs of the Minnesota above the Fort. This subsequent accumulation is so abundant above the Fort along the Minnesota, that the strike of the Trenton limestone is totally hid within less than a mile.

The direction of the Mississippi changes at Fort Snelling, making a right angle, from S. E. to N. E., but the change is caused by its entering the wide gorge which runs in that direction. The wide valley in which the Minnesota runs is out of proportion with the amount of water which it carries, but its valley continues of the same width, and in the same direction beyond the confluence of the Mississippi, the valley taking the latter name.

Below Fort Snelling, opposite the mouth of the Minnesota, is a low, long, alluvial island, (Pike Island,) running to a point downstream. The existence of this island, which lies in the wide gorge, and which must have been formed since the excavation of the gorge, points directly to some force not now existing; since the joint action of the two streams uniting, instead of accumulation, would be the reverse under normal conditions. If the volume of the two rivers were to be increased so as to have sufficient momentum to move the substructure of Pike Island, the result would be the gradual destruction and removal of the island, instead of its increase. The retardation of the current causes it to drop sediment, but when two streams unite, the current is not retarded, but generally by reason of closer confinement in a proportionately narrower channel, it is increased.

The right bank of the Mississippi, just below the confluence of the two streams, shows, for about half a mile, a fresh erosion of the rock-bluff similar to that of the bluffs above the fort, the current of the river having been driven against that bank so as to undermine the limerock and cause its downfall. This is opposite the point at which the Mississippi enters the wide gorge. Pike Island lies alongside of it, and between it and the debouchure of the Mississippi into the wide gorge.

Above the mouth of Bassett's creek the Mississippi runs between rock-bluffs of the same kind as those below Fort Snelling. They are about a mile apart and show all the above named indications of greater age. They, however, rise but about thirty or forty feet above the river, and are buried under the loam, or under the drift and loam. This old valley continues southwardly by way of Bassett's creek, and its course, as supposed, is expressed on the accompanying map of the region, drawn on a scale of one inch to one mile. This old valley was cut down into the St. Peter sandstone over one hundred feet, since it has been drilled into at the Sumner Schoolhouse in Minneapolis without striking rock, to even a greater depth than that.

From the foregoing facts the following interesting history may be read. It is believed that the glacial theory of L. Agassiz, and nothing but that, will explain the grand changes which this history relates.

Prior to the last glacial epoch the Mississippi river did not run over the Trenton limerock at all, but passed, in a wide, deep valley, similar to that which it now occupies below Fort Snelling, by way of the valley of Bassett's creek, and lakes Calhoun, Harriet and others, along the western side of the Trenton area, and joined the Minnesota at some point above Fort Snelling, but probably between Shakopee and Fort Snelling. The country was then covered with the drift of an older glacial epoch, and was probably timbered with species of trees the same as those now living.

As the last glacial epoch approached, the transport of drift material was from the northwest. After the closing of the northward outlet of the Winnipeg waters by the accumulated ice and the perpetual winter, they were drained southwardly through the valley of Big Stone lake and Lake Traverse, into the Minnesota valley, and thence into the Mississippi, past the site of Fort Snelling. Their volume was augmented not only by the proper volume of the Minnesota itself, but by the dissolution of the ice of the glacier that gradually crept over the state from the north, and northwest, as it arrived in latitudes too genial for the existence of ice.

The land ice not only disrupted the old drift surface and distributed its material as it moved on, but also gathered a great deal of the bed-rock itself, particularly of the Cretaceous. This Cretaceous debris, being abundant and easily transported, gave its own

stamped on the clay of this drift period a peculiar and characteristic quality, thus rendering it easily distinguishable from the older drift which was of a red color and charged with small red or green stones, with few granite boulders. The later drift contains more numerous large granite boulders than the older. Round the southern limit of the land ice, the old red drift was thrown up into hills and ridges and shoved into old valleys, and locally mixed with, or covered by, the gray drift of the later period.

In the valleys, particularly those having a southward drainage, the gray drift was transported most freely and distributed most widely, partly by the agency of the abundant water. The Minnesota was much larger than the Mississippi, and the Mississippi was much larger than it is now. Large quantities of floating ice would also pass down these streams, carrying from the glacier, stones and gravel, distributing them on the then flood-plains, the now gravelly terraces of the Mississippi.

The margin of the ice did not extend across the Minnesota into Dakota county.—At least it did not obstruct the Minnesota river so as to permanently divert it from its course, and certainly did not reach far south of that river, since the isolated outliers of the St. Peter, (as Castle Rock,) round whose bases the older drift lies, were not destroyed. The ice choked up the old valley of the Mississippi below the mouth of Bassett's creek, and filled it with drift clay, the river itself being, at the acme of the cold, reduced to smaller dimensions by the contraction of the field drained, and by the changed topography of the country toward the north. The river was thus forced to pass round the eastern foot of the ice further to the southeast, a lake of standing water perhaps covering the valley which it had abandoned, and setting back into a portion of the valley still occupied. This water, fresh from the glacier, was very muddy, and gave origin to the brick-clay that lies in its old valley, as shown by the accompanying map showing the surface geology.

The Mississippi, thus forced out of its old channel, after rising to the level of the limerock of the Lower Trenton, ran *over* the rock, to reach the same valley again by plunging over the precipice at Fort Snelling, thus giving birth to the Falls of St. Anthony. In reaching that point it had crowded on to the old drift bluffs along the east side of the river, driving them, by erosion, further toward the east, while the old valley itself served to retard, and even to limit, the transportation of the drift clay toward the east.

Later, as the volume of the river increased by the dissolution of the ice and the opening of the tributary valleys as it withdrew, the waters spread over the whole area from the line of the old drift bluffs on the east, to the recently made moraines along its west banks, receiving and distributing not only gravel and sand over the whole broad valley, as at Minneapolis, but also large quantities of the gray hardpan clay.

It was at this time that Pike Island began to form; and also that the current of the Minnesota was carried, by the added momentum of the Mississippi, against the opposite bluffs below Mankato, so as to produce new exposures of the sand and limerock.

The Falls must have begun at Fort Snelling near the acme of the cold, as the effect of the ice is not important at any points south or east of the mouth of Bassett's creek. They have occupied the interval of time elapsed since then in receding to their present position. Were it possible to establish a unit of recession for a calculation, the length of that interval could be computed. The rate has been much greater since the construction of dams and mills, diverting the water, or concentrating it at points; and hence the data of recession since the permanent occupancy of the region, are valueless for this purpose. The only other means of estimating the rate of natural recession is to employ the statements of the early travelers who have described the Falls. Their discoverer was Father Louis Hennepin. In returning from his captivity among the Dakotas, he saw the Falls in July, 1680, and briefly describes them as follows: "This fall is forty or fifty feet high, divided in the middle by a rocky island of pyramidal form."

"In ascending this river ten or twelve leagues, navigation is interrupted by a fall, which we named in honor of St. Anthony of Padua, whom we had chosen as patron of our enterprises. This fall is 50 or 60 feet in hight, and has an island of rock, in the form of a pyramid, in the middle of the chute." (See the Amsterdam edition of Hennepin's works, 1704, chapter 44, p. 319.) A translation of Hennepin's narration is found in the *Historical Collections of Louisiana, Part IV*, in which he gives "40 or 50" feet as the hight of the fall.

In the London edition of Carver's journal, 1778, p. 69, Carver thus describes the Falls of St. Anthony, as he saw them in 1766: "This amazing body of waters, which are above 250 yards over, form a most pleasing cataract; they fall perpendicularly about 30 ft., and the rapids below, in the space of 300 yards more, render the descent considerably greater. * * * * * * In the middle of the falls stands a small island, about 40 feet broad, and somewhat longer, on which grew a few cragged hemlock and spruce trees; and about half way between this island and the eastern shore is a rock lying at the very edge of the fall in an oblique position, that appeared to be about five or six feet broad, and 30 or 40 long. * * * * At a little distance below the falls stands a small island, of about an acre and a half, on which grow a great number of oak trees, every branch of which, able to support the weight, was full of eagles' nests."

The engraving accompanying this description is that seen in *Winterbottom's America*, and is reproduced in *Harper's New Monthly Magazine for October*, 1875, and wrongly attributed to Father Hennepin. Carver's original engraving shows an island above the falls, which is omitted in the copy in Harper's. Carver states on the engraving that the breadth of the fall is about 600 feet. This engraving shows an insignificant island just in the brink of the falls, extending neither below nor above the falls, and an apparently detached block of limerock lodged on the brink between it and the eastern (or northern) shore. In the stream below the falls is represented a larger low island, not rocky, but alluvial, nearly circu-

Lieut. Z. M. Pike visited the falls of St. Anthony Sept. 30, 1805. His journal, published in London in 1811, is entitled: *Exploratory Travels through the Western Territories of North America in* 1805–6–7. He says of the falls: "The Falls of St. Anthony did not strike me with that majestic appearance which I had been taught to expect from the descriptions of other travelers. On an actual survey I find the portage to be 260 poles, but when the river is not very low, boats ascending may put in 31 poles below at a large cedar tree, which would reduce it to 229 poles. The hill on which the portage is made is 69 ft. ascent, with an elevation at the point of debarkation of 45°. The fall of the water between the point of debarkation and of re-loading is 58 feet; the perpendicular fall of the chute is 16½ feet; the width of the river above the chute 627 yards, below 209. In high water the appearance is much more sublime, as the great quantity of water then forms a spray which in clear weather reflects from some positions the colors of the rainbow, and when the sky is overcast, covers the falls in gloom and chaotic majesty."

Major Stephen H. Long visited the Falls of St. Anthony in a six-oared boat in 1817. His journal, which was not published till 1860, and then by the Minnesota Historical Society, gives a more minute description of the Falls than that of any of his predecessors. The courtesy of Rev. E. D. Neill renders it possible to give a transcript from this rare document.* "The perpendicular fall of the water at the cataract, as stated by Pike in his journal, is sixteen and a half feet, which I found to be true by actual measurement. To this hight, however, four or five feet may be added for the rapid descent which immediately succeeds the perpendicular fall within a few yards below. Immediately at the cataract the river is divided into two parts by an island which extends considerably above and below the cataract, and is about five hundred yards long. The channel on the right side of the island is about three times the width of that on the left. The quantity of water passing through them is not, however, in the same proportion, as about one-third part of the whole passes through the left channel. In the broadest channel, just below the cataract, is a small island also, about fifty yards in length and thirty in breadth. Both of these islands contain the same kind of rocky formation as the banks of the river, and are nearly as high. Besides these there are immediately at the foot of the cataract two islands of very inconsiderable size, situated in the right channel also. The rapids commence several hundred yards above the cataract, and continue about eight miles below. The fall of the water, beginning at the head of the rapids, and extending two hundred and sixty rods down the river to where the portage road commences, below the cataract, is, according to Pike, fifty-eight feet. If this estimate be correct the whole fall from the head to the foot of the rapids, is not probably much less than one hundred feet. But as I had no instrument sufficiently accurate to level, where the view must necessarily be pretty extensive, I took no pains to ascertain the extent of

*Voyage of a six-oared skiff to the Falls of St. Anthony in 1817, by Major Stephen H. Long, T. E., U. S. A.

the fall. The mode I adopted to ascertain the hight of the cataract was to suspend a line and plummet from the table rock on the south side of the river, which, at the same time, had very little water passing over it, as the river was unusually low."

Beltrami in 1823* thus describes the Falls: "Seated on the top of an elevated promontory, I see, at half a mile distance, two great masses of water unite at the foot of an island which they encircle, and whose majestic trees deck them with the loveliest hues, in which all the magic play of light and shade are reflected on their brilliant surface. From this point they rush down a rapid descent about 200 feet long, and, breaking against the scattered rocks which obstruct their passage, they spray up and dash together in a thousand varied forms. They then fall into a transverse basin, in the form of a cradle, and are urged upward by the force of gravitation against the side of a precipice which seems to stop them a moment only to increase the violence with which they fling themselves down a depth of twenty feet. The rocks against which these great volumes of water dash, throw them back in white foam and glittering spray; then plunging into the cavities which this mighty fall has hollowed, they rush forth again in tumultuous waves, they once more break against a great mass of sandstone forming a little island in the midst of their bed, on which two thick maples spread their shady branches."

Keating, who narrates Maj. Long's Expedition in 1823, says, (Vol II, p. 306.)

"On the 6th of July we walked to the falls of St. Anthony, which are situated nine miles (along the course of the river, seven by land) above the fort. The first glimpse which we caught of the fall was productive of disappointment, because it yielded but a partial view, but this was amply redeemed by the prospect which we obtained of it when the whole fall opened itself before us. We then discovered that nothing could be more picturesque than this cascade. We had been told that it appeared like a mere mill-dam, and we were apprehensive lest a fall of sixteen feet would lose all its beauty when extended upon a breadth of several hundred yards; but we soon observed that this was by no means the case. The irregular outline of the fall, by dividing its breadth, gives a more impressive character. An island, stretched in the river both above and below the fall, separates it into two unequal parts, the eastern being two hundred and thirty yards wide, and the western three hundred and ten. The island itself is about one hundred yards wide. From the nature of the rock, which breaks into angular, and apparently rhomboidal, fragments of a large size, this fall is subdivided into small cascades, which adhere to each other so as to form a sheet of water unrent, but composed of an alternation of retiring and salient angles, and presenting a great variety of shapes and shades; each of these forms in itself a perfect cascade, but when taken together in one comprehensive view they assume a beauty of which we could have scarcely deemed them susceptible. * * * * * * * * * Concerning the hight of

* *A Pilgrimage in Europe and America, leading to the discovery of the sources of the Mississippi and Bloody river. J. C. Beltrami. London, 1828. Vol. 2, p. 205.*

the fall, and breadth of the river at this place, much incorrect information has been published. Hennepin, who was the first European who visited it, states it to be fifty or sixty feet high. It was this traveler that gave it the name which it now bears, in honor of St. Anthony of Padua, whom he had taken for the protector of his discovery. He says of it, that it 'indeed of itself is terrible, and hath something very astonishing.' This hight is, by Carver, reduced to about 30 feet; his strictures upon Hennepin, whom he taxes with exaggeration, might with great propriety be retorted upon himself; and we feel strongly inclined to say of him, as he said of his predecessor, 'the good father, I fear, too often had no other foundation for his accounts than report, or at least a slight inspection.' Pike, who is more correct than any traveler whose steps we have followed, states the perpendicular fall at sixteen and a half feet; Major Long measured it in 1817, with a plumb line, from the table rock from which the water was falling, and found it to be the same. Mr. Colhoun measured it while we were there with a rough water level, and made it about fifteen feet. The difference of a foot is trifling, and depends upon the place where the measurement was made; but we cannot account for the statement made by Mr. Schoolcraft, that the river has a perpendicular pitch of forty feet, and this so late as fourteen years after Pike's measurement. The same author states the breadth of the river, near the brink of the fall, to be two hundred and twenty-seven yards, while Pike found it to be six hundred and twenty-seven yards, which agrees tolerably well with a measurement made on the ice. Messrs. Say and Colhoun obtained an approximate admeasurement of five hundred and ninety-four yards; this resulted from a trigonometrical calculation, the angles having been measured with a compass that was small and not nicely graduated, and the base line having been obtained under unfavorable circumstances. Below the fall the river contracts to about two hundred yards. There is a considerable rapid both above and below; a portage of two hundred and sixty poles in length is usually made here; the whole fall, or difference of level between the place of disembarking and reloading, is stated by Pike to be fifty-eight feet, which is probably very near the truth; the whole fall to the foot of the rapids, which extend several miles down the river, may be estimated as not far short of one hundred feet."

Mr. G. W. Featherstonhaugh says (*Report of a Geological Reconnoissance made in* 1835 *from the seat of government to the Coteau de Prairie*:) "An island about 450 yards long divides the Mississippi into two parts at the Falls of St. Anthony, which have a very irregular outline, owing to the soft sandstone being washed out unequally in places, and the superincumbent strata of limestone falling down in large blocks; these are piled up in large quantities on the bed of the river immediately at the foot of the falls. That part of the river on the north side of the island is about two hundred and twenty yards in width. There is a very fine smooth section of the rocks here to the water, about 90 feet. I should think the fall would not average more than twenty feet. * * * * * On the south side of the river the line of the falls is a very irregu-

lar curvature, and measures about 450 yards to the island. The hight of the fall does not appear so great on this side, owing perhaps to the bed of the river being so much choked up with the fallen slabs. It is a wild rocky scene, but deficient in interest as a waterfall on account of its want of hight."

Data.

From these descriptions the following data may be eliminated:

Hennepin, 1680—Pyramidal island in the middle of the fall. Hight of fall 50 or 60 feet (or "40 or 50 feet.")

Carver, 1766—Width of river 250 yards (or "about 600 feet;") hight of the fall 30 feet; a small island in the middle of the fall 40 feet broad and "somewhat longer," with hemlock and spruce trees, and another of an acre and a half a little below the falls, with great quantities of eagles' nests; an island also above the falls; an oblique rock in the brink of the falls half way between the island and the east shore, "about five or six feet broad and thirty or forty long."

Pike in 1805—Portage 260 poles; waterfall 16½ feet; width of river above the falls 627 yards; below 209.

Long in 1817—Island 500 yards long divides the cataract and river above and below the falls; channel on the west side three times that on the east side; one-third of the water descends the east channel; waterfall 16½ feet. In the broadest channel, just below the cataract is a small island, 50 yards by 30; both islands rocky, with the same formations as in the banks, "and nearly as high;" two others of inconsiderable size immediately at the foot of the falls, both in the right channel.

Beltrami in 1823—Only distinctly mentions an island in the falls, and an island of sandstone below, with maples.

Keating in 1823—Island in the river both above and below the fall, separating it into two unequal parts, the eastern 230 yards wide, the western 310; the island is 100 yards wide; total width of river at the falls about 594 yards, with rough data; below the fall the river contracts to about 200 yards.

Featherstonhaugh in 1835.—Island 450 yards long divides the fall unequally; east channel 220 yards wide, west channel 450; fall 20 feet average.

* In 1856, just before the erection of permanent mills, and the diversion of the water so as to disturb the recession, the falls on the west of the island were, in general terms, abreast of the sawmill of Farnham and Lovejoy. They had a bend upward in the center of the channel, and a sweep downward near the west shore. Their ends were nearly opposite each other. The total width of the river, including Hennepin island, was 1,700 feet at the falls. Putting together the statements of the earliest settlers, the downward sweep of the falls along the east side of the west channel met the island about 100 feet below the lowest portion of the flat undisturbed portion of the limerock on which Farnham and Love-

* These statements are made on the authority of Messrs. Chute, Dr. A. E. Johnson and Mr. S. W. Farnham.

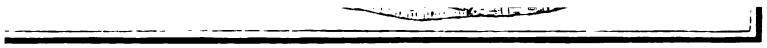
joy's milldam is erected, the mill itself having originally been erected in a little notch or jog in the falls, partly on the limerock and partly below the falls, close on the shore of the island. Since then the falls in the west channel have receded about 500 feet, hastened by these artificial means; the falls on the east side, having been more protected, have not receded any perceptible amount.

Considering all these statements, and adjusting their descriptions with each other and with the known position of the Falls in 1856, before the permanent improvements for milling were made, the following conclusions may be made out:

Hennepin saw the falls in 1680, when Spirit island divided them, and their hight was much greater than now. The river gorge is 1,350 feet wide across Spirit island. The confinement of the water in this narrower channel caused the greater hight of the fall.

Carver saw the falls in 1766, just as they were leaving Spirit island and entering on Hennepin island. The "oblique rock" seen was the submerged toe, or lower, rocky end of Hennepin island. No doubt the river completely surrounded the visible part of Hennepin island, *above the brink of the falls;* the rock, which is its substructure, only showing a small area in the fall. The rhomboidal masses, into which the limerock is cut by pre-existing jointage flaws, would very likely cause an oblique fracture along the brink, as piece after piece fell, as fully detailed by Keating in 1823 in describing the west channel. The width of the whole channel at this point, stated by Carver as about 600 feet, is 1400 feet by careful measurement. The island which Carver's engraving shows above the falls must be intended for Hennepin island which now divides the fall, but is very much out of the right position—even to represent any island. The island which his engraving shows in the brink of the falls was the upper end of Spirit island, while the low island below the falls, on which he mentions great quantities of eagles nests, can be no other than the lower end of the same island,* the narrow limerock having fallen away in the intervening space, making really (if his engraving shows correctly at this point) two parts, or islands, each being rocky. His engraving is the copy of his pencil-sketch, made probably from memory after he had left the place, and the representation of an island as *low*, which ought to have been *high* and rocky, rendered somewhat necessary to avoid the hiding of the falls, and engraved in London, would be no unexpected error, and would hardly be regarded an imperfection by any but a geologist or a professional artist. It is possible also, if his sketch was made after he left the place, *that there was really but one island of the whole.* His attention had been directed during his stay to *the island with the eagles' nests*, about which he speculates at some length in his journal, and to *the island dividing the falls.* When he came to make his sketch he represented both prominent ideas without regard to the exact manner in which they were topographically related or united; and finding that a continued *high* island would hide the west channel, (his view being from the east bank) which would materially interfere with the general effect of his illustration, he so reduced the

*Spirit Island (what was left of it) in 1856, was still the abode of eagles.





hight of the lower portion of the island as to make it appear like another island: the engraver then perpetuated the *appearance*, not knowing the facts. Whichever hypothesis be correct, it is not possible for the island represented in the brink of the falls, to have been Hennepin island. Besides the general agreement of the whole account with the accounts of future travelers, on the supposition of its having been Spirit island, and the statement that it was *in the middle of the falls*, Carver's engraving shows *two men in the act of portage of a canoe along the east shore*, below the falls; showing that the view presented was intended to represent the *principal fall*, (if not the whole,) while the channel on the east of Hennepin island is now, and always has been, since it began, about one-third that on the west side. Thus Carver's description, aided by his very imperfect illustration, fixes the position of the falls in 1766 at the very foot of Hennepin island.

When Lieut. Pike arrived in 1805 probably nothing remained of Spirit island in the brink of the falls, though he gives no description of the falls themselves.

In 1817, when Major S. H. Long first visited them, Hennepin island divided them unequally, and Spirit island was wholly below the falls, and is described as high and rocky, with the same formations as are seen in the banks of the river. This statement demonstrates the incorrectness of Carver's engraving in this particular. If Carver did not see that high, rocky island, it never could have got there, where it exists still, between his visit and that of Long.

In 1823, Keating and Beltrami saw the falls in pretty much the same position as Long in 1817.

Again, Featherstonhaugh, in 1835, repeats the same general description.

There has been no published careful measurement of the river from Fort Snelling to St. Anthony Falls, but a lining of the map constructed by Gen. G. K. Warren, with the U. S. township and section lines represented, makes the distance almost exactly eight miles. Prof. Rhame has made for the survey a series of triangulations and chain measurements at the falls, and in the gorge below, with the view of finding the distance the falls have receded since Carver's visit to 1856, and also since Hennepin's discovery. A line across the river gorge through Spirit island may represent the position of the falls at the time of their discovery; another across the foot of Hennepin island with an upward curve in the west channel will represent Carver's line of the falls, and another, one hundred feet below the limerock on which stands Farnham and Lovejoy's mill-dam, may represent them in 1856. It is evident that the interval between Carver's time and 1856, is the most reliable datum, the statements of Hennepin not enabling us to determine *at what point* in Spirit island the falls were when he first saw them. Still, for the purpose of comparison, a point has been assumed as that at which they were when abreast of Spirit island at the time of Hennepin's visit, and Prof. Rhame has taken measurements from it. That point is about the middle of the undisturbed limerock of the island, and 415 feet above the line of the upper end of the piers of the lower bridge immediately below, in a large re-entrant

angle in the undisturbed limerock on the east side of the island, which angle runs from the top of the limerock to the bottom. The interval between Hennepin's line and that of Carver is 300 feet, between that of Carver's and that of 1856, is 606 feet, making the whole recession since Hennepin 906 feet.

Conclusion.

Between Hennepin, 1680, and 1856, are 176 years; the recession in that time was 906 feet, or an average of 5.15 feet per year. The time needed at that rate to recede from Fort Snelling would be 8,202 years.

Between Hennepin and Carver are 86 years; the amount of recession was about 300 feet, or 3.49 feet per year. The time needed at that rate to recede from Fort Snelling would be 12,103 years.

Between Carver in 1766, and 1856, were 90 years; the recession in that interval was 606 feet, or 6.73 feet per year; at that rate it would take 6,276 years to recede from Fort Snelling.

The average of these three results is 8,859 years. Still, the exactness of the datum between Carver and 1856, is such that the actual time of such recession is probably more nearly expressed by taking that only into the calculation. This brings the glacial period to a much more recent date than some other means of calculation; but it is probable that no other datum so exact for such a calculation has ever before been used.

The only elements of possible error in this calculation are:—changes in the volume of the river, and incorrect statement for the length of the gorge between the falls and Fort Snelling.

In regard to the first of these elements of uncertainty, it is true that the river may have been larger during the first portion of its occupancy of this channel, on account of the proximity of the glacial ice, and the recession hence more rapid than during the latter; yet the width of the gorge between the rock-bluffs does not perceptibly change from Fort Snelling to the present position of the falls. Indeed, the widest portion of this gorge seems to be where the falls are at the present time. Again, the *datum* for the calculation is all taken from the latter portion of the time involved, and would more than balance any error in the opposite direction. It is not altogether certain, moreover, that an increase of the volume of water would hasten the recession. The rate of recession is dependent on the rapidity of the undermining of the limerock by the retro-action of the falling water on the loose sandrock. While the increased momentum of the water, incident to an increase of volume, would *highten* the falls, by digging deeper into the sandrock, it would by that very change remove further from the limerock the retro-action of the falls, and hence would leave a quantity of undisturbed sandrock to support longer the limerock. In regard to the second element of uncertainty, it would be found that the gorge, if measured carefully, is a little longer than eight miles rather than less.

If the occurrence of our winter in aphelion, caused by the pre-

cession of the equinoxes and the revolution of the line of the apsides, about 11,300 years ago, was the cause of our last glacial period, the greatest *effect* of those causes which had their greatest *force* at that time, was probably felt at a considerably later date, as suggested by Prof. Rhame, in the same manner as the greatest heat of summer is not felt at the same time when the causes which produce it have their greatest activity.

This subject has been treated of by Dr. E. Andrews, in a paper read last year before the Chicago Academy of Sciences, but the writer has only seen a telegraphic newspaper notice of it. The same data employed by Dr. Andrews were furnished the writer by Mr. J. L. Gillespie, of the U. S. Engineers' office, St. Paul, and are employed and extended in the data foregoing.

The reader is referred to the Report of the Chief of Engineers, 1875, Part I, p. 385, for Gen. G. K. Warren's *Essay concerning important physical features exhibited in the valley of the Minnesota river, and upon their signification.*

Neill's history of Minnesota from the French Explorations to the present time.

Father Hennepin's works, published at Paris, Utrecht, London, Amsterdam, and other cities, to the number of twenty-two editions, from 1683 to 1742.

Historical collections of Louisiana, Part IV, contains original narratives of Hennepin and others relative to the early exploration of the Mississippi river, translated into English.

Three years' travels throughout the interior parts of North America. Jonathan Carver, 1766–7–8.

Voyage in a Six-oared Skiff to the Falls of St. Anthony in 1817. By Major Stephen H. Long. Collections of the Minnesota Historical Society.

Narrative Journal of travels from Detroit northwest through the great chain of lakes to the sources of the Mississippi river, in 1820. H. R. Schoolcraft.

Narrative of an expedition to the Sources of the St. Peter, Lake Winnepeek, &c., in 1823, under Major S. H. Long; by W. H. Keating.

Geological Reconnoissance made in 1835 *from the seat of government to the Coteau de Prairie.* G. W. Featherstonhaugh.

Material Resources. Fuel.

There is a large annual cut of cord-wood from the timbered portions of Hennepin county, which finds market at Minneapolis and St. Paul. This comprises sugar maple, iron wood, oak, bass, elm and soft maple. The price per cord varies with the stringency of the money market. During the past year hard wood has brought five and six dollars per cord. Osseo is an important primary wood-mart; but large quantities are hauled by the first owners directly into Minneapolis. The county is generally heavily wooded, the thinly wooded and prairie portions being along the valleys of the Mississippi and Minnesota rivers, in the southeastern portion.

Building Stone.

The quarries on the east side of the river, most accessible, are owned by the St. Anthony Falls Water Power Company, and are leased by them to various parties, mainly to Patterson and Baxter.

The quarries on Hennepin island are turned over to the Government for use in the tunnel, but are owned by the St. Anthony Falls Water Power Company.

The quarries on Nicollet island are owned by Eastman and Company and are worked by Henry and Abrams.

The Mississippi and Rum river Boom Company have opened some quarries near 13th street north on the east side of the river, and take from the old river bluffs, back from the river, a thin and weathered stone for their piers. There are also a great many openings in the upper portion of the E. Division, by parties owning lots that cover the brink of the Trenton terrace. In these cases attention was called to the rock generally in making excavations for cellars.

The quarries below the University a short distance, furnished the stone for the older portion of the University building. The rest of the building was constructed from quarries on Nicollet island. Quarries are now wrought below the University near the "Old Cheever Landing," by Edward Maloney, and Mr. Malone.

The quarries on the west side of the river are owned by various parties, the whole being cut up into lots according to the city subdivisions. Banks Arenson, Andrew Ernson, Michael Delaney, Holscher and Weeks, Henry Wax and George McMullen own those below the falls opposite the University.

Three-fourths of a mile below these are quarries opened by Franklin Cook and Edward Murphy.

Quarries in Sec. 32, Bloomington, are owned by H. T. Welles and by Mr. Neuser.

The stone taken from these quarries is, in general, an aluminous blue limerock, without much variation in characters. It is true that there are two or more different, distinct, strata, with different qualities of rock, as described in giving the sections of the Lower Trenton, but the great bulk of the building stone is taken from the same stratum, about 15 ft. in thickness, which is the persistent stratum occupying the immediate brink of the Falls of St. Anthony. The rock of this stratum varies only with the degree of exposure to which it has been subjected, so far as it is seen in Hennepin county.

In the upper part of the city, along the bluffs of the old river, as in the quarries opposite Boom island, and on the county line of Anoka county, this rock is very different, to a considerable depth, from that taken out below the falls. It shows the effects of very long weathering, probably dating from pre-glacial times. These differences are all accounted for by the known effect of water and iron, with the aid of time, on the shale with which the Lower Trenton is permeated. The thin sheets of shale, which appear as dark belts of irregular and crooked direction on the newly-cut face of a "dimension stone," begin to decompose after the lapse

of a number of years, causing a shattering and splitting of the whole mass. When the change takes place under the surface of the earth, but where the natural surface waters get free access, the iron that always accompanies such water, aided by the pyrites of the rock itself, gives a rusty and dirty, or yellowish color to the rock to a considerable depth. This is marked sometimes by the slow decomposition of the limestone itself, and by the sprinkling of sand or loam that covers the rock. In the face of these changes it is no wonder that a great many who have not watched them closely should be firmly persuaded that the different aspects could not be assumed by the same rock.

Stone sells from 50 cents per perch of 16½ feet (for "gray rock") to 65 cents. This is for rough, non-dimension stone. For range rock, ("blue stone,") water table, 75 cents to $1.00 per foot, cut; uncut 15 to 18 cents per foot.

Brick and Pottery.

There is a small pottery establishment in upper St. Anthony, owned by Louis Kampf, the clay being taken from the Mississippi bank adjoining. The jars are light-colored, but not cream-colored.

The following brick-yards were noted in Hennepin county:

Peterson and Swansen, N. E. ¼ Sec. 12, Crystal Lake, above the mouth of Shingle creek. The brick made here are cream-colored; except, if poorly burnt, the topmost tier of the kiln has a reddish color. They are molded in water. Although this is the first year this yard has been opened, it will turn out about 700,000. Delivered in Minneapolis these brick sell for $8.00 per thousand; at the yard for $7.00 per thousand. Mixed wood costs $2.25 to $2.50 per cord.

The Union Brick Company, (Baxter, Woodward and McNair,) Minneapolis, have made two and a half millions the present season (1876;) generally burn five millions per year. Sell for $9.00 per thousand, average price. Soft wood (basswood) costs $3.25 to $3.50 per cord; mixed wood (all kinds except hard maple and basswood) costs $3.75 to $4.00 per cord delivered at the yard. For a description of the clay the reader is referred to the drift-sections preceding. The brick are cream-colored.

Daniel Woodbury's yard is a short distance above the Union Brick Company's yard, within the valley of Bassett's creek, and he uses the same general deposit of clay, but perhaps encounters more calcareous matter in the form of concretions and bivalve shells. His brick are cream-colored, and also reddish. Mixed wood costs here $3.25, delivered; makes 400,000 per year, selling at $8.50 per thousand, or $9.00, according to the haul.

At Dayton, brick are made by Medorre Arseno, his yard being the same as that occupied 21 years ago by Lyman Dayton, situated on the north side of Crow river. The brick, which sell for $8.50 per thousand, at the kiln, are generally of a cream color, but those from the outside of the kiln are tinged with red. Two or three kilns per year are made here. Mixed wood is worth $1.50 per cord; hard wood $2.00.

In Upper St. Anthony the old brick-yard of Charles Grotjann has been closed. The brick made were red, and were not readily saleable.

Geo. Erhardt has opened a new yard at the N. end of Lake Calhoun, and sells red brick at $8.00 per thousand, or $8.50 delivered.

Quick-lime.

There has been some lime burnt from the Lower Trenton at Minneapolis, but nothing is being done at the present time. There is one old pot-kiln, below the falls, within the river gorge, built of lime-rock, owned by ———

Levi Guia burns lime from boulders at Dayton. His kiln has been erected eleven years, and is emptied sometimes to the number of six times per year. He sells at Anoka, Princeton, Elk River, Monticello and Dayton, and sometimes at Minneapolis, from $1.50 to $1.75 per barrel. Another establishment of the same kind is run at Frankfort, in Wright county, by Mr. Burnings, and another at Otsego by Mr. Ingleson.

Mills and Water-powers.

The following extracts, from the Annual Report of the Minneapolis Board of Trade for 1876, by C. C. Sturtevant, secretary, convey a correct idea of the importance of the water-powers of Hennepin county, and particularly of the Falls of St. Anthony;

"The vast water power which has given to Minneapolis her pre-eminence as the great manufacturing centre of the Northwest, and is destined to make it the chief commercial city of the State, is furnished by the Mississippi river, which has a fall of 82 feet within the city limits. The volume of water passing over these falls and rapids at the ordinary stage has been estimated by competent engineers at 120,000 horse-power. Most of it can be used with the present improvements with from 40 to 60 feet head, and the entire flow is available for manufacturing purposes. The first practical use made of this power was in 1848, when a dam was built from Hennepin island to the east shore, and four saw mills erected on it. It was not till 1857, however, that the present substantial improvements were fairly inaugurated. On the 26th of February, 1856, the St. Anthony Falls Water Power Company was chartered by the Territorial Legislature, and on the 27th of the same month and year the Minneapolis Mill Company was chartered. Both charters are perpetual, the former controlling the water from the centre of the channel on the west side of Hennepin island to the east shore, the latter from the same point to the west shore.

"Robert Smith, of Alton, Illinois, was the first president of the Minneapolis Mill Company, and in 1857, W. D. Washburn, Esq., was appointed secretary and agent. The same year C. H. Bigelow, of Lawrence, Mass., a civil and hydraulic engineer, made surveys and submitted plans for improving the water-power of the

Mill Company. The construction of the dam and opening of the canal, commenced in September, 1857, and the dam was completed in January, 1858. The first flouring mill (the Cataract) was built by Eastman and Gibson the same year.

"The appliances for controlling and utilizing the water-power of this company consist of a low or waste dam built on the ledge, commencing in the center of the channel of the river and connecting with the dam of the St. Anthony Water-Power Company, thence running down stream diagonally toward the westerly shore 400 feet; thence a high dam again down the stream, parallel with the shore 500 feet, forming a pond above the mills; thence at right angels 400 feet to the pier at the head of the canal, upon which last portion is built the block of saw mills. With this dam a head of 13 feet is obtained, and a sufficient supply of water is directed to the canal, while the large proportion of the water passes over the low dam and is wasted on the falls.

"The canal is excavated along the shore 350 feet to a point opposite the brink of the fall, of a width narrowing from 80 feet to 55 feet, and below this point 500 feet further of a uniform width of 55 feet, and carrying a depth of 14 feet of water.

"The mills located upon the property improved by the Minneapolis Mill Company are as follows:

(1.) *Upon or near the canal and supplied with water therefrom.*

Sixteen Flouring Mills, 181 runs of stone.
One Woolen Mill.
One Cotton Mill.
One Iron Works.
One Railroad Machine Shop.
One Planing Mill, Sash, Door and Blind Factory.
One Paper Mill.
One 300,000 bushel Grain Elevator.
One Machine Shop.
One Mill-furnishing Shop.
One Carding Mill.

(2.) *Upon the dam of the Company:*

Seven Saw-mills, having nine gangs, seven double circulars, and other appropriate machinery; daily capacity 900,000 feet.

(3.) *Upon the river bank above the canal, and discharging water through the First street tunnel:*

One Saw Mill.
One Planing Mill.
One Machine Shop.
The City Water Works.

"The total amount of power utilized by the Company is about 4,500 horse power.

"The present officers of the Company are Gen. C. C. Wash-

burn, President; R. J. Baldwin, Treasurer; William D. Hale, Secretary and Agent; C. C. Washburn, D. Morrison, W. D. Washburn, R. J. Baldwin and C. J. Martin, Directors

"The improvements of the St. Anthony Falls Water Power Company consist of a dam from the east shore to Hennepin island, 400 feet up the shore of Hennepin island, 650 feet from head of island, west 200 feet, thence diagonally to the dam of the Minneapolis Mill Company, 600 feet; total length of dam, 1,850 feet. The Company has sold eight saw-mill sites on the dam in the east channel, which, together with two flouring mills, one machine shop, and other mills, renting power for manufacturing purposes, utilize about 1,300 horse power under varying heads.

"The whole water-fall on the Company's lands is 69 feet. In all further developments it will be the aim of the Company to use the water under a head of from 40 to 60 feet, voiding the water through a tunnel, or tail-race, now excavated in the sand-rock under the limestone ledge.

"The original improvements, made at an early day, amounting to some twenty mills, of different kinds, were destroyed, mainly by fire, some eight years since, and have been replaced by substantial structures. The Company are now in a condition to utilize to the highest capacity the power controlled by them, and it offers to manufacturers a field unsurpassed in the Northwest.

"The present officers of the company are Richard Chute, President; Samuel H. Chute, Agent; Ernest Ortman, Treasurer.

"In addition to the mills located on the power controlled by these companies there is one large paper mill and one double saw mill in operation. By the above it will be seen that only a small portion of this vast water-power is now in use, while the improvements of these companies have rendered the whole flow of water available."

* * * * * * * * * * * *

"The permanency of this water power is now established beyond a question. There was a time when fears were expressed that the ledge which forms the falls might at some future day be swept away by the action of the water; but all apprehensions of such a catastrophe are at an end. The Government in providing for the improvement of the navigation of the river above, aided by the water power companies and the city, has now completed such works as render the falls secure for all future time."

Flouring Mills in operation in Minneapolis in 1876.

	Name.	When Built.	Number Runs of Stone.	Name of Firm.
1.	Cataract	1859	10	D. R. Barber and Son.
2.	Union	1860	5	Darrow and Dibble.
3.	Arctic	1861	5	Hobart, Shuler & Co.
4.	Pillsbury	1865	11	C. A. Pillsbury & Co.
5.	Minneapolis	1865	9	Crocker, Fisk & Co.
6.	Washburn B	1865	11	Washburn & Hazard.
7.	Dakota	1867	6	S. S. Brown & Co.
8.	Zenith	1871	6	Day, Rollins & Co.
9.	City	1862	5	J. C. Berry & Co.
10.	North Star	1870	5	H. J. G. Crosswell.
11.	Holly	1872	4	W. F. Cahill & Co.
12.	Empire	1872	9	C. A. Pillsbury & Co.
13.	Palisade	1873	11	L. Day & Sons.
14.	Washburn A	1873	41	J. A. Christian & Co.
15.	Galaxy	1874	12	W. P. Ankeny.
16.	Anchor	1874	12	C A. Pillsbury & Co.
17.	Hennepin	1875	6	Mills, Thompson & Co.
18.	Humboldt	1875	6	Bull, Newton & Co.
19.	Phœnix	1876	5	Stamwitz and Shober.
20.	Pettit and Robinson	1876	15	Pettit and Robinson.

"The product of the foregoing mills for the year 1876 was as follows:

	Product.	Value.
Flour, barrels	1,135,160	$6,810,960
Bran, tons	50,945	509,450
		$7,320,410

"The total shipment of flour, in car lots, from Minneapolis by rail during the year 1876, amounts to 1,000,676 barrels. A large quantity is shipped in small lots, and sent out by teams, while the city consumption amounts to 40,000 barrels. There were also 50,000 barrels in store in the city. These several amounts make up the difference between the production and the shipment.

Lumber Mills in operation in Minneapolis in 1876.

Owner.	Lumber.	Shingles.	Lath.
Morrison Bros.	13,597,000	1,645,000	2,565,000
J. Dean & Co	14,128,164	6,955,000	1,650,850
Pettit & Robinson	8,000,000	3,500,000	850,000
Minneapolis Lumber Co	17,000,000	5,000,000	
J. B. Bassett	8,500,000	3,000,000	2,000,000
Eastman and Bovey	10,200,000	3,000,000	1,300,000
Farnham & Lovejoy	23,500,000		
O. C. Merriman	19,936,404	2,701,750	2,319,500
Minneapolis Mill Co., two mills	12,557,537	2,580,500	2,818,000
Elias Moses	8,000,000	3,000,000	2,000,000
F. P. Clark	11,500,000		2,000,000
McMullen & Co	2,000,000	10,000,000	
F. G. Mayo	3,850,000	4,600,000	450,000
Todd, Haven, Leavitt & Co	9,500,000	4,500,000	500,000
W. C. Baker, Assignee	13,752,172	4,522,000	1,406,000
Lee Brothers & Co	500,000	5,000,000	
Wm. H. Eldred		23,000,000	
Jno. Gains	8,000,000	2,000,000	1,500,000
	184,521,277	85,004,250	21,359,350

"The production of lumber was the first manufacturing industry introduced into Minneapolis, and has added more largely to the population of the city than any other branch of business. The first mill was erected in 1848, but all the original mills built have given place to new and improved structures. At this time there are eighteen sawmills and one shingle mill in the city. Nearly all the saw mills have shingle and lath mills attached. The lumber product is distributed through the states of Minnesota, Iowa, Missouri, Kansas, Nebraska, and the territory of Dakota. The most of it is shipped by rail, although a small portion is rafted below the falls and floated down the Mississippi river to St. Louis and other points."

Mills in operation in Hennepin County outside the city of Minneapolis.

Pratt and Baird, Richfield P. O.; custom and ship to Minneapolis; 4 runs of stone; seven feet head; dam in Minnehaha creek.

Craik and Sons, Edina Mills (also known as the Red Mills;) dam in Minnehaha creek; 13 feet head; 4 runs of stone; custom and ships at Minneapolis.

Metz and Peacka, below Minnehaha Falls; dam in Minnehaha creek; 11 feet head; two runs of stone; custom.

Baxter and Northway, Champlin; Champlin Mills; two runs of stone; Elm Creek power; fall 16 feet; shipping and custom.

Weitzel and Hurlbut, Dayton; Dayton Mills; Crow river power; fall 9 feet; five runs of stone; ships at Itasca.

Henry Weitzel, sec. 10, Maple Grove ; Maple Grove Mills ; Elm creek power ; 12 feet fall ; two runs of stone ; custom.

McAfee and company, N. W. ¼ sec. 21, Bloomington ; Bloomington Mill ; 26 feet head ; three runs of stone.

Balm Brothers, sec. 26, Eden Prairie ; Eden Prairie Mills; two runs of stone.

Minnetonka Mill Company, Minnetonka City ; Minnetonka Mills ; dam in Minnehaha creek ; 12 feet head ; seven runs of stone ; shipping.

Herrick, Douglas & Co., on Minnehaha creek ; Globe Mills ; eight feet head ; four runs of stone ; shipping.

Medicinal Waters.

Some of the springs of the county have a local repute for medicinal qualities. The Chalybeate Springs of Minneapolis consist of a copious discharge of water from the top of the shale layer between the main calcareous members of the Lower Trenton in the bluff of the river. They are situated just below the falls, on the east side of the river. The overlying layer of limerock is parted along some planes and allows the water to enter it, but the shale is nearly impervious, and sheds it. The water is not originally from the rock, but is the drainage from the drift, and the bog swamp east of St. Anthony. It probably derives its iron from the ferriferous drift of the bluffs east of St. Anthony; passes into the swamp, deposits, after evaporation, a considerable iron as a bog iron ore, and carries on what it does not leave in the swamp, penetrating the gravelly and sandy drift between the swamp and the river bank. The iron is deposited as a peroxide on the rock over which the water runs. The taste of the water is very pleasant, and is similar to that of a number of wells, which afford Chalybeate water, situated further back from the river and on the margin of the swamp. Although this water is known as Chalybeate, from the copious deposit of iron it gives on exposure to the air, yet the quantity of iron present is very small.

On analysis Mr. S. Dana Hayes, of Boston, has said: "When heated it evolves gas ; after some evaporation it becomes opalescent, and finally deposits a precipitate, while it becomes more and more alkaline. It has the chemical character, and is strictly an *alkaline mineral water*, resembling well-known waters found in the northern part of Vermont, and in Germany and elsewhere in Europe." Mr. Hayes gives the following

Analysis.

"One United States gallon, or 231 cubic inches, contains nineteen and eighty-four hundredths grains of solid dry mineral matter, consisting of:

Potash	1.257
Soda	1.900
Sodium	.060
Lime	5.394

Magnesia	1.589
Ammonia	Trace
Alumina	Trace
Protoxide of Iron	.028
Sulphuric acid	.117
Chlorine	.104
Silicic acid	.645
Carbonic acid, combined	8.106
Crenic acid, organic	640
Total	19.846

"These elements are probably combined in the water forming the following salts and compounds:

Carbonate of potash	Sulphate of potash.
Carbonate of soda	Silicate of soda.
Carbonate of lime	Chloride of Sodium.
Carbonate of magnesia	Crenate of iron, etc.

"All the corbonates named exist in the state of bicarbonates; and the gases present are carbonic acid, oxygen and nitrogen; the water containing three and three-tenths volumes of mixed gases in one hundred volumes of water. The aeration of this water renders it a pleasant beverage, and prevents the sense of heaviness after it has been drank in quantities. Beside the alternative medicinal qualities possessed by this water when taken internally, it will be found beneficial in hot and cold baths, especially in certain cases of skin disease. And it may be bottled and kept, retaining all its virtues for months without material alteration."

The Russell Mineral Spring, situated near the margin of the same swamp, is described by Prof. Peckham on page 61, of the general report for 1876. This water has nearly the same chemical composition as that above mentioned, and within less than a grain the same total solid matter per gallon, deposits on exposure a peroxide of iron, and is probably from another drainage course from the same general reservoir—the peat marsh lying between the river and the drift bluffs, on the east side of the river.

At points a little further down the river, near the University, the water that runs down the bluff from springs issuing near the top of the bluff, deposits a calcareous tufa, which, in favorable circumstances, has become several feet thick. When the spattering water falls on moss, which often grows in such damp spots, it covers the moss with a film of carbonate of lime which, by gradually increasing, imprisons the moss, killing it, but takes its form and even its name, the moss itself gradually oxidizing and passing off in the air, as grass decays on the prairie. The deposit—loose and spongy—is then known as "Petrified Moss."

The "Great Medicine Spring," an old resort for the Indians, is situated a few miles west of Minneapolis, on the land of Mr. Wales. It also is chalybeate, but its exact chemical qualities are not known.

Earthworks.

Hennepin county presents a rich field for the anthropologist,

a field, however, which has not been much explored. In the survey of the county artificial mounds were seen in a number of places; the following were noted:

There are two large mounds on the south bank of Crow river, at Dayton, forty feet across and about ten feet in hight.

Four are on Mr. Aaron Hoag's land, sec. 18, Hassan.

There is another large mound on James Ream's land, two miles above Dayton, on the north side of the river.

There are a great many mounds along the Minnesota river, above Fort Snelling; two or three on sec. 1, Bloomington; one is on the road near Mr. Van Ness', near the line between sections 1 and 12, Bloomington They occur on Mr. Brosseau's land, sec. 14, and frequently, along the bluff, further up, as far as Shakopee at least.

There is a large mound on sec. 27, Eden Prairie, visible for some distance across the prairie.

There is a mound on S. E. ¼ sec. 1, Minnetonka, near Wayzata.

At Mound City, at the western end of Lake Minnetonka, are "about 40" mounds on Sec 24, Minnetrista. A number of others are on Nobles island, near the same place; others are on N. Saunders' farm near Halstead's Bay, Sec. 22. There are others at Excelsior, on P. M. Gideon's land, Sec. 28.

Some at Palmer's lake have been opened by members of the Minnesota Academy of Natural Sciences, and their contents described by Dr. A. E. Johnson. A fine specimen of a shin-bone, characteristic of the Mound-Builders was taken from a mound at Palmer lake.

On the land of James Shaver, NW. ¼ Sec. 17, Minnetonka, are a great many mounds. In the summer of 1875 a number of these were located by chain and compass by a party from the Minnesota Academy of Sciences. They were found to lie on the bluff and knolls overlooking the water of the lake, following the higher land, without regard to direction or relative position. No plan or order was discernable, though about 20 were carefully surveyed. They vary in height from two or three feet to five or six, and from ten feet in diameter to forty. There are in that neighborhood fifty or more within the area of a quarter-section of land.

Eight mounds of the same kind are seen on Widow Ferguson's land, Sec. 23, Excelsior, also overlooking the lake. Others are on NW. ¼ Sec. 11, Medina, land of Albert Johnson; and on Samuel Barto's, Sec. 7, Minnetonka; a large one is on the first high point east of Gale's island, on Big island.

IX.

REPORT ON THE GENERAL MUSEUM.

CONTAINING THE COLLECTIONS OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY; FOR THE YEAR 1876.

By N. H. Winchell, Curator.

During the Fall of 1875 the cases designed for the Museum were completed so far as they had been contracted for, and during the Christmas vacation they were filled by the display of the Ward Casts. Another larger case was immediately built in the same room for the reception of the mounted mammals. Thus three sides of the room were occupied with suitable cases. In the center were placed some of the larger of the casts, including the Glyptodon, and the Mastodon, on pedestals. The Megatherium is also designed for this group, but has not yet been unboxed. It became evident at once that the room, even if supplied with all the cases it could contain, was too small to accommodate the collections on hand. The Regents have concluded therefore to carry out the original plan and to devote the other large room, across the hall from the first, to a strictly geological and mineralogical cabinet, reserving the first mainly for zoological specimens.

Several boxes of fossils belonging to the survey were opened and carefully studied and labeled during the summer, but owing to the lack of suitable cases they were retained in the geological laboratory. Mr. Herrick labeled the shells on exhibition that were purchased of H. T. Woodman, and collected about a hundred native birds. These are not mounted, but are skinned and stuffed.

The Museum has had large accessions during the year through donations and purchases at the Centennial Exhibition. Some of these specimens have been catalogued and labeled, as may be seen by the accompanying statement, but the most of them have not. The principal donors were the following:

The Geological Survey of Canada, through A. R. C. Selwyn, Director.

The Central Pacific R. R. California.
The Pennsylvania Diamond Drill Company.
The Wisconsin Geological Survey, through Mr. E. T. Sweet.
The Pacific Guano Company.
The Kentucky Geological Survey, through John R. Proctor, Secretary of the Survey.
Tennessee Centennial Commission, through Gen. J. T. Wilder.
The Land Department of the Little Rock and Fort Smith R. R.
The Selma, Rome and Dalton R. R. Alabama.

Some minerals also were purchased at favorable rates of Mr. Herbert R. Saunders and of Prof. A. E. Foote.

The most important addition to the mineralogical collections made during the year was in the purchase of the entire cabinet collection of Mr. Geo. F. Kunz, of Hoboken, N. J. This has not been received yet at the University, and is not enumerated in the following catalogue. In general it embraces a complete set of zinc and iron ores, and species, so far as they can be got in the locality of Franklin and Ogdensburg, N. J.; also a collection prepared by the late Charles Clifton, for Owen's college, England; also a general series of mineral species in excess of the foregoing zinc and iron compounds amounting to at least 125 species, with many duplicates. Fifteen boxes of this collection have been received. There are still about twenty more. No systematic attempt has been made to catalogue the zoological specimens. The following is a list of the geological and mineralogical specimens so far as they have been examined and labeled:

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
51			Quartz in Greenstone.....	1			No records of any kind.
52			Saccharoidal marble.....	1			" "
53			Serpentine rock, (Ophiolyte.).	1			" "
54	1872	J. F. Kenworthy...		4		Hamilton.....	Records in doubt.
55	"	" ..		2		"	" "
56	"	" ..		17		"	" "
57	"	" ..		4		"	" "
58	"	" ..		10		"	" "
59	"	" ..		7		"	" "
60	"	" ..		1		"	" "
61	"	" ..		1		"	" "
62	"	" ..		7		"	" "
63	"	" ..		1		"	" "
64	"	" ..		2		"	" "
65	"	" ..		1		"	" "
66	"	" ..		56		"	" "
67	"	" ..		1		"	" "
68			Haematite (botryoidal),.....	1			No records whatever.
69			Galenite.....	23			" "
70			Calcite.....	2			" "
71			Pyrite.....	9			" "
72			Pyrite and Galenite.....	1			" "
73		Dr. Stoneman	Glass quartz.....	2			Records doubtful.
74		"	Strophomena alternata. Con.	1		Trenton.	" "
75		"	Strophomena alternata. Con.	1		"	" "

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
27			Amygdaloid with Epidote	1		Metamorphic.	No records.
28			Amygdaloid with Epidote	2		"	" "
29			Calcite as a segregated vein in Argillite.	1		"	" "
30			Calcite in Argillite (or Jasper)	1		"	" "
31			Porphyrytic Granite	1			" "
32			Franklinite	1	Franklin, N. J		" "
33			Syenite	1			" "
34			Marble (rosy)	1			" "
35			Quartzite	1			" "
36			Mica Schist	1			" "
37			White Sandstone	1			" "
38			Grit	1			" "
39			Conglomerate	1			" "
40			Marble (reddish)	1			" "
41			Marble (white)	4			" "
42			Hydromia Slate	1			" "
43			Catlinite	1	Pipestone Co., Minn.	Potsdam	" "
44			Syenite ?	1	St. Cloud		Seems to contain only Labordorite and Quartz.
45			Granite ?	1			No records of any kind.
46			Calciferous Sandrock	1		Lower Mag	" " "
47			Gypsum	2	Fort Dodge, Iowa		" " "
48			Gneiss	1			" " "
49			Grit	1			" " "
50			Pyrites and Chert	1			" " "

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
101		Prof. Beardsley	"Jasper"	1	W. Rutland, Vt.		
102		" "	"Chalcopyrite"	1	S. Hampton, Mass.		
103		" "	"Copper Pyrites"	2	" "		
104		" "	Chalcopyrites and Chrysocolla	1	?		
105		" "	"Serpentine"	1	Chester, Mass.		
106		" "	"Margarite"	5	" "		
107		" "	"Muscovite and Quartz"	1	?		
108		" "	"Soapstone with Garnets"	1	Chester, Mass.		
109		" "	"Garnets" in Soapstone	1	" "		
110		" "	"Talc"	1	" "		
111		" "	"Steatite"	1	" "		
112		" "	"Emery"	1	" "		
113		" "	"Hornblende"	1	" "		
114		" "	"Serpentine"	1	" "		
115		" "	"Emery Mine"	1	" "		
116		" "	"Corundum"	4	" "		
117		" "	"Corundum"	1	" "		
118		" "	"Galena"	2	S. Hampton, Mass.		Lead Mines at S. Hampton.
119		" "	"Talcose Schist"	2	" "		
120		" "	Calcite on opalescent and drusy Quartz	1	" "		
121		" "	Quartz	2	" "		
122		" "	Calcite and (actinolite ?)	1	" "		
123		" "		1	" "		
124		" "	"Galena"		" "		
125		Burdett Thayer	Large crystal of Quartz		Near Montreal, Ont.		

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
76			Lead	1		Trenton ?	Records doubtful.
77		Dr. Stoneman	Cyathophylloids	3		"	" "
78		" "	Chaetetes sp.?	2		"	" "
79		" "	Chaetetes Lycoperdon. H.	7		"	" "
80		" "	Chaetetes sp.?	1		"	" "
81		" "	Crinoid stems	3		"	" "
82		" "	Orthis lynx	1		"	" "
83		" "	Resembles in shape Pleurotomaria subconica.	2			Has not the proper surface markings.
84		" "	Murchisonia ventricosa. H. (or perangulata.)	1			Records doubtful.
85		" "	Drusy Quartz	1			" "
86		" "	Native Copper	1			" "
87		" "	Barite	2			" "
88		" "	Selenite	1	Kansas		" "
89		" "	Endoceras angusticameratum. H.	1		Trenton	" "
90		" "	Fossiliferous Limestone	1		"	" "
91		" "	?	1		"	" "
92		" "	Quartzite pebble	1			" "
93		" "	Conglomerate	1			" "
94		" "	Strophomena sp.?	2			" "
95		" "	Strophomena sp.?	3			" "
96		" "	Strophomena sp.?	3			" "
97		Prof. Beardsley	"Variegated marble"	1	West Rutland, Vt.		
98		" "	"Traprock"	1	Mt. Holyoke, Mass.		
99		" "	New Red Sandstone	1			
100		" "	Conglomerate. New Red Sandstone	1	Mt. Holyoke, Mass.		

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
151	Oct. 1875	Geol. Surv.	Chaetetes ?	2	Chatfield	Trenton	N. H. Winchell.
152	Sept. "	" "	Receptaculites Oweni. Hall	2	Sec. 17, Rochester, Olm. Co.	Galena	M. W. Harrington.
153	" "	" "	Receptaculites Oweni. Hall	1	" " "	Galena	"
154	Oct. "	" "	"Receptaculites globularis. H." (After M. & W.)	1	Chatfield	L. Trenton	N. H. Winchell. (Ill. Rep., Vol. III, p. 301.)
155	Sept. "	" "	Endoceras proteiforme. Var. strangulatum. H.	1	Cascade, Olmsted Co.	L. Trenton	M. W. Harrington. (Jenkins' q'ry.)
156	Oct. "	" "		1	Sec. 20, Beaver, Fill. Co.	Devonian	N. H. Winchell.
157	Sept. "	" "	Receptaculites Oweni. Hall	1	Sec. 17, Rochester, Olm. Co.	Galena	M. W. Harrington. (Garrick's q'ry.)
158	" "	" "	Receptaculites. sp. ?	1	" " "	Galena	" "
159	" "	" "	Ormoceras tenuifilium. Hall	2	" " "	Gray Limestone.	" (below Garrick's q.)
160	" "	" "	Receptaculites. sp. ?	1	" " "	Galena	" (Garrick's q'ry)
161	" "	" "	Receptaculites Oweni. Hall	4	" " "	Galena	" "
162	" "	" "	Petraia corniculum. Hall	1	" " "	Galena	" "
163	" "	" "	Illaenus latidorsata. Hall ?	1	" " "	Galena	" "
164	" "	" "	Receptaculites Oweni. Hall	1	Olmsted county	Galena	" "
165	Oct. "	" "	Maclurea magna. Hall	1	Weisbach's Mill, Fill. Co.	Trenton	N. H. Winchell.
166	July "	" "	Maclurea magna ?	1	Northfield ?	Shakopee	"
167	Sept. "	" "	Receptaculites occidentalis. Sal. ?	2	Manterville, Dodge Co.	Galena	S. Wilson.
168	" "	" "	Conularia Trentonensis. Hall	1	" " Wilson's quarry.	Galena	The longitudinal striæ are not quite like the figures of Hall, Plate 59. M. W. Harrington. (Upper layer.)
169	" "	" "	Receptaculites. sp. ?	1	Rochester, Olmsted Co	Galena	M. W. Harrington.
170	Oct. "	" "	Chaetetes. ?	1	2 miles N. E. Spring Valley.	Trenton	N. H. Winchell.
171	Sept. "	" "		2	No. 7, Viola, Olm. Co.	Galena	M. W. Harrington.
172	" "	" "		1	" " "	Galena	"
173	Oct. "	" "	Productus. ?	4	Spring Valley	Galena. ?	N. H. Winchell.
174	Sept. "	" "	Strophomena. sp. ?	1	Garrick's quarry, Rochester	Galena	M. W. Harrington.
175	Oct. "	" "		1	Etna, Fillmore Co	Drift	N. H. Winchell.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
126	Oct. 1872..	Geol. Sur	Endoceras magniventrum. Hall	3	Mantorville.....	Galena,....	N. H. Winchell.
127	"	W. D. Hurlburt.. ...	Endoceras magniventrum. Hall....	1	Near Rochester.....	"	"
128	"	"		1	"	"	"
129	"	Geol. Sur.....		1	Mantorville.....	"	"
130	"	" "		1	Mantorville ?	Trenton ...	"
131	"	" "	Orthoceras multicameratum. Con.	1	Pettit's Mill.....	" ...	"
132	Sept. 1875	" "	Endoceras magniventrum. Hall....	9	Sec 7, Viola, Olm. Co.....	Galena.....	M. W. Harrington.
133	"	W. P. Farrell.....	Endoceras proteiforme. Hall.....	2	NE¼, Sec. 32, Dover, Olm. Co..	"	M. W. Harrington.
134	Oct 1875.	John Kleckler.....	Lituites undatus. Con.....	1	2 ms. N.E. Spring Valley.....	Trenton ...	N. H. Winchell.
135	Sept. 1875	Geol. Sur.....	Endoceras magniventrum. Hall....	1	Sec. 7, Viola, Olm. Co	Galena.....	M. W. Harrington.
136	"	" "		2		" ...	"
137	Oct. 1875.	" "	Endoceras magniventrum. Hall....	2	Fountain, Fill. Co.....	Trenton ...	N. H. Winchell.
138	"	John Kleckler.....	Endoceras distans.....	1	2 ms. N.E. Spring Valley.....	" ...	"
139	Oct. 1872.	Geol. Sur..... ...	Endoceras magniventrum. Hall....	1	Mantorville.....	Galena.....	"
140	Oct. 1875.	John Kleckler		1	2 ms. N.E. Spring Valley.....	Trenton ...	"
141	"	" "		1	" " "	" ..	"
142	Sept. 1875	Geol. Surv.....	Endoceras magniventrum. Hall....	1	Olmsted Co.....	" ...	M. W. Harrington.
143	"	Rev. H. P. Satchwell.		1	Salem, Olm. Co.....	" ...	" (Quarry of John Vosburg.)
144	"	Geol. Surv.....	Endoceras proteiforme. Hall.....	4	Cascade, Olm. Co.....	" ...	" (Jenkins' Quarry.)
145	Jan. 1876.	S. H. Chute.....	Endoceras magniventrum. Hall....	2	Minneapolis, E.....	" ...	N. H. Winchell (From green shales.)
146		W. P. Farrell.....	Receptaculites sp.?	1	N.E.¼, Sec. 32, Dover, Olm. Co.	Galena.....	M. W. Harrington.
147	1875.....	Geol. Surv	Receptaculites Oweni. Hall.....	8	Sec. 7, Viola, Olm. Co	"	"
148	1875.....	" "		1	Fillmore Co.....	"	N. H Winchell.
149	1875.....	Geo. Shepard.....		1	"	"	"
150	1875.....	Geol. Surv.....	Receptaculites occidentalis. Sal....	1	Jordan, Fillmore Co	Trenton ...	"

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of specimens.	Locality.	Formation.	Collector and Remarks.
201		Geol. Surv.....	Strophomena deltoidea. Con.....	1	Minnehaha	Trenton....	N. H. Winchell.
202		" "	Edmondiea subtruncata. Hall ?.....	2	"	" ...	"
203		" "	Strophomena deltoidea. Con.....	2	"	" ...	"
204	1875.	" "	" tenuistriata, Sow. (allied to)	2	Sec. 17, Rochester, Olmsted Co	Galena....	M. W. Harrington.
205	"	" "	Receptaculites ?.....	1	" "	"	M. W. Harrington.
206	"	" "	Chaetetes Sp, ?.....	1	Finn's Glen, Minneapolis.....	Trenton...	N. H. Winchell.
207	"	" "	Petraia corniculum. Hall.....	1	Sec. 17, Rochester, Olmsted Co	Galena....	M. W. Harrington.
208	"	" "		1	" "	"	"
209	"	" "	Strophomena tenuistriata ?.....	1	" "	" ...	"
210	"	" "	Phacops rana ?	1	High Forest.....		
211	"	" "	Chaetetes petropolitanus. Pand...	1	2 miles N. E. Spring Valley...	Trenton....	N. H. Winchell.
212	"	" "		1	" " " ...	"	"
213	"	" "	Endoceras distans. Hall.....	1	" " " ...	"	"
214	"	" "		1	Spring Valley.....	Galena....	"
216	"	" "	Pleurotomaria umbilicata. Hall,.....	1	St. Anthony.....	Trenton....	"
217	"	" "		1	Rochester, (Garrick's Quarry)	Galena....	M. W. Harrington.
218	Oct. 1872.	" "	Murchisonia subfusiformis. Hall.....	1	Mantorville, (Pettit's Mill)....	Trenton....	N. H. Winchell, (compare 343 and 356.)
219	"	" "		1	" " . .	" ..	M. W. Harrington.
220	Sept. 1875.	" "	Orthis, Leptaena nucleata (?)..... Productus. Atrypa. 428 and 299.	1	Sec. 23, Bloomfield	Galena ?...	N. H. Winchell.
221		" "		1	Chester, Iowa.....	Devonian..	"
222		" "		1	" "	" ..	"
223		" "		2	" "	" ..	"
224		" "		1	" "	" ..	"
225	Oct. 1875.	" "		1	" "	" ..	"

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	
176	1875	Geol. Sur.	Murchisonia bicincta. Hall. Isotelus gigas. Hall. Orthis? Streptelasma corniculum. H. Leptaena? Murchisonia perangulata. Hall. Murchisonia angustata. H.	2	Rochester, (Garrick's quarry.)	Galena.	M
177	"	"	Rhynchonella sp. ?	1	" "	"	
178	"	"	Murchisonia bellicincta. Hall	1	" "	"	
179	"	"	Non-septate, portion of an orthoceras shell.	1	" "	"	
180	1872	"	Strophomena deltoidea. Con.	1	Minneapolis	Trenton.	N
181	"	"	" recta. Con.	2	St. Charles	"	
182	1875	"	" alternata. Con.	1	Rochester, (Garrick's quarry.)	Galena.	M
183	"	"	Pleurotomaria umbilicata. Hall	1	" "	"	
184	"	"	" ambigua. Hall. (or umbilicata.)	1	" "	"	
185	"	"		8	Fillmore County	Trenton.	N
186	"	"		1	" "	"	
187	"	"	Orthis ?	1	" "	Galena.	
188	"	"		1	Spring Valley	"	
189	"	"		1	Fillmore County	Trenton.	
190	"	"		1	" "	"	
191	"	"		1	" "	"	
192	"	"		1	" "	"	
193	"	"	Strophomena sp. ?	1	" "	"	
194	"	"		1	" "	"	
195	"	"		1	" "	"	
196	"	"	Pleurotomaria lenticularis. Con.	1	" "	"	
197	"	"	Orthoceratite ?	1	" "	"	
198		"		1	Spring Valley	"	
199		"	Strophomena deltoidea. Con.	3	Minnehaha	"	
200		"		1	"	"	

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.		Whence.		Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
251	Oct.	1875	Geol.	Surv.	Maclurea Logani. Sal.....	14	Lime City, Fillmore Co.....	Trenton....	N. H. Winchell.
252	July	1875	"	"		1	Holden, Goodhue Co.....	"	" "
253	Oct.	1875	"	"	Maclurea magna. Hall.....	1	Lime City, Fillmore Co.....	"	" "
254	"	"	"	"		1	" "	"	" "
255	"	"	"	"	Murchisonia subfusiformis. Hall? ...	1	" "	"	" " compare 343 & 318
256	"	"	"	"	Receptaculites occidentalis. Sal.....	1	" "	"	" "
257	"	"	"	"	Receptaculites Oweni. Hall.....	1	" "	"	" "
258	"	"	"	"		3	" "	"	" "
259	"	"	"	"	Chaetetes Lycoperdon. Hall	37	Fillmore, Fill. Co., (Shepherd's quarry).....	"	" "
260	Sept.	1875	"	"	Fragment of trilobite shield?.....	1	Mantorville.....	Galena.....	M. W. Harrington.
261	"	"	"	"	Strophomena sp.?.....	1	"	"	" "
262	"	"	"	"	" fluctuosa. Bill.....	1	"	"	" "
263	"	"	"	"	Discina Pelopea. Bill.....	1	"	" ...	" "
264	Sep.	1875	"	"		2	Olmsted Co.....	Trenton ...	
265	Oct.	1875	"	"		2	Sec. 26, Bloomfield, Fill. Co.....	Galena.....	N. H. Winchell.
266	"	"	"	"	Rhynchonella capax. Con. (increbescens of Hall.) Has the internal markings of Atrypa but the shape of a Rhynchonella. ? (Eatonia ?).....		Fillmore, Fill. Co.....	Trenton ...	" "
267	"	"	"	"		24	Spring Valley.....	Galena?. ..	" "
268	"	"	"	"		1	Sec 26, Bloomfield.....	"	" "
269	"	"	"	"		1	Sec. 30, Forestville, Fill. Co.....	Trenton....	" "
270	"	"	"	"	Same as No. 267, (shows a number of fragments).....	2	Spring Valley.....	Galena?....	" "
271	"	"	"	"	Slab with Strophomena sp.?.....	1	Mantorville, Dodge Co.....	Trenton ...	M. W. Harrington.
272	"	"	"	"	Orthis testudinaria. Dal....	Indefinite	Spring Valley.....	Galena.....	N. H. Winchell.
273	"	"	"	"	Orthis plicatella. Hall.....	1	" "	"	The dorsal beak is but slightly more prominent than that of the ventral valve. The casts of the interior of the dorsal valve are not with a "subquadrangular visceral impression." Pal. N. Y. I., p. 126.
274	"	"	"	"	" subquadrata. Hall. ?	Indefinite	" "	"	
275	"	"	"	"	Strophomena nitens. Bill?..	3	" "	" . ..	The areas seem not to form an angle greater than 90°.

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
226	Oct. 1875.....	Geol. Surv.....		2	Forreston, Iowa.....	Galena.....	N. H. Winchell.
227	"	" "	Spirifer. Productus and Leptaena nucleata?..	1	Spring Valley	" ?....	"
228	"	" "	Strophomena sp.?.....	1	Fillmore County	Trenton ...	"
229	"	" "	Spirifer sp.?.....	1	Spring Valley	Galena?....	"
230	"	" "	"	1	" "	"	"
231	"	" "	Orthis testudinaria. Dal.....	1	" "	Galena.....	"
232	"	" "	Strophomena fluctuosa. Bill	1	" "	"	"
233	June, 1873 ...	" "	Cyclonema?.....	1	Finn's Glen, Minneapolis....	Trenton ...	"
234	" ...	" "	Spirifer sp.?.....	1	Spring Valley.....	Galena?....	"
235	Oct. 1875.....	" "	Productus sp.? (distorted.)	1	" "	" ?....	"
236	"	" "	Orthis testudinaria. Dal.....	1	" "	Galena.....	"
237	"	" "		1	" "	"	"
238	"	" "	Spirifer and Productus.....	1	" "	Galena?....	"
239	"	" "		1	Chatfield.....	Trenton ...	"
240	"	" "		6	High Forest.....		"
241	"	" "	Orthoceras, with remains of trilobites.....	2	Holden, Goodhue Co.....	Trenton ...	"
242	"	" "		2	" "	" ...	"
243	"	" "		1	" "	" ...	"
244	"	" "		1	" "	" ...	"
245	"	" "		3	" "	" ...	"
246	"	" "		1	" "		"
247	"	" "		1	" "		"
248	"	" "		3	Sec. 20, Beaver, Fillmore Co.	Devonian..	"
249	"	" "		5	" "	" ..	"
250	"	" "		2	" "	" ..	"

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Serial No.	Obtained. When.		Whence.		Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
251	Oct.	1875	Geol. Surv.		Maclurea Logani. Sal.	14	Lime City, Fillmore Co.	Trenton.	N. H. Winchell.
252	July	1875	"	"		1	Holden, Goodhue Co.	"	" "
253	Oct.	1875	"	"	Maclurea magna. Hall.	1	Lime City, Fillmore Co.	"	" "
254	"	"	"	"		1	" "	"	" " compare 343 & 318
255	"	"	"	"	Murchisonia subfusiformis. Hall?	1	" "	"	" "
256	"	"	"	"	Receptaculites occidentalis. Sal.	1	" "	"	" "
257	"	"	"	"	Receptaculites Oweni. Hall.	1	" "	"	" "
258	"	"	"	"		3	" "	"	" "
259	"	"	"	"	Chaetetes Lycoperdon. Hall	37	Fillmore, Fill. Co., (Shepherd's quarry)	"	" "
260	Sept.	1875	"	"	Fragment of trilobite shield?	1	Mantorville	Galena.	M. W. Harrington.
261	"	"	"	"	Strophomena sp.?	1	"	"	" "
262	"	"	"	"	" fluctuosa. Bill.	1	"	"	" "
263	"	"	"	"	Discina Pelopea. Bill.	1	"	"	" "
264	Sep.	1875	"	"		2	Olmsted Co.	Trenton	" "
265	Oct.	1875	"	"		2	Sec. 26, Bloomfield, Fill. Co.	Galena.	N. H. Winchell.
266	"	"	"	"	Rhynchonella capax. Con. (increbescens of Hall.) Has the internal markings of Atrypa but the shape of a Rhynchonella. ? (Eatonia ?)		Fillmore, Fill. Co.	Trenton	" "
267	"	"	"	"		24	Spring Valley	Galena?.	" "
268	"	"	"	"		1	Sec 25, Bloomfield	"	" "
269	"	"	"	"		1	Sec. 30, Forestville, Fill. Co.	Trenton.	" "
270	"	"	"	"	Same as No. 267, (shows a number of fragments)	2	Spring Valley	Galena?.	" "
271	"	"	"	"	Slab with Strophomena sp.?	1	Mantorville, Dodge Co.	Trenton	M. W. Harrington.
272	"	"	"	"	Orthis testudinaria. Dal.	Indefinite	Spring Valley	Galena.	N. H. Winchell.
273	"	"	"	"	Orthis plicatella. Hall.	1	" "	"	The dorsal beak is but slightly more prominent than that of the ventral valve. The casts of the interior of the dorsal valve are not with a "subquadrangular visceral impression." Pal. N. Y. I., p. 126.
274	"	"	"	"	" subquadrata. Hall. ?	Indefinite	" "	"	The areas seem not to form an angle greater than 90°.
275	"	"	"	"	Strophomena nitens. Bill?	3	" "	"	

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Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
276	Oct. 1875	Geol. Surv.	Petraia. ?	1	Spring Valley	Galena	N. H. Winchell.
277	" "	" "	Cast of an Orthis, (not subquadrata.)	1	"	"	"
278	" "	" "	Orthis Plicatella. Hall. (v. 273.)	2	"	"	"
279	" "	" "		4	"	"	"
280	" "	" "	Leptaena nucleata. (v. 220)	2	Sec. 22, Bloomfield	" ?	"
281	" "	" "	Chaetetes. (Or Bolboporites, Geol. Can., p. 124.)	3	Minneapolis	Trenton	"
282	" "	" "	Chaetetes Lycoperdon. Hall	1	"	"	"
283	" "	" "	Rhynchonella capax. Con.	1	"	"	"
284	Sept. "	" "	Murchisonia bellicincta. Hall	1	Sumner tp., Fillmore Co.	"	Geo. Ten Eyck. (N. H. W.)
285	" "	" "	Pleurotomaria. sp. ?	1	" "	"	" "
286	" "	" "	(Resembles Macrocheilus.)	1	" "	"	" "
287	" "	" "	Strophomena alternata. Con.	1	" "	"	" "
288	" "	" "	Maclurea Logani. Sal. (with a Strophomena attached).	1	" "	"	" "
289	" "	" "		1	Wasioja, Dodge Co.	Galena	M. W. Harrington.
290	" "	" "	Orthis. sp. ?	1	Rochester. (Garrick's q.)	"	"
291	" "	" "	Lingula quadrata. Eich	2	Olmsted Co	Trenton	W. D. Hurlburt.
292	" "	" "	Chaetetes. (And a fucoidal fragment.)	5	Sec. 25, Cascade, Olm. Co.		M. W. Harrington.
293	" "	" "		2	Mantorville, Dodge Co.	Galena	" (Upper layers Wilson's quarry.)
294	" "	" "		1	" "	"	M. W. Harrington.
295	" "	" "		1	" "	"	"
296	" "	" "		1	" "	"	"
297	" "	" "	Strophomena fluctuosa. Bill.	1	" "	"	N. H. Winchell—Has a part of a pygidium of a trilobite.
298	Oct. "	" "		1	High Forest		N. H. Winchell.
299	" "	" "	Atrypa ? Eatonia ? (v. 220 and 428)	2	Sec. 22, Bloomfield	Galena ?	"
300	" "	" "		1	" "	"	"

Catalogue of the Geological and Mineralogical Specimens of the Museum to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
301	1875.....	Geol. Surv.	Productus ?.....	1	Sec. 22, Bloomfield, Fill. Co.	Galena ?.....	N. H. Winchell.
302	"	" "		2	Forestville, Fill. Co	Maquoketa.....	" (S.E. qr. Sec. 20.)
303	Oct. 1875	" "		1	Lime Springs, Iowa.....	Niagara.....	"
304	"	" "	Orthoceras multicameratum. Con..	1	Minneapolis.....	Trenton	"
305	"	" "	Murchisonia bellicincta. Hall.....	1	Sec. 2, Forestville, Fill. Co..	"	"
306	"	" "	Pleurotomaria umbilicata. Hall....	1	" " " ..	"	"
307	"	" "		1	Sec. 21, " " ..	"	"
308	"	" "		1	Lime Springs, Iowa	Niagara.....	"
309	"	" "	Lingula Cobourgensis. Bill.....	1	Chatfield, Fillmore Co.....	Trenton	"
310	"	" "	Chaetetes petropolitanus. Pander..	1	Rochester.....	"	W. D. Hurlburt.
311	"	" "		2	Spring Valley	Galena ?.....	N. H. Winchell.
312	"	" "	Orthis occidentalis. Hall? v. 220..	1	" "	" ?.....	N. H. Winchell—Resembles Leptaena nucleata H. of the Oriskany. (Ill Rep. III. p. 393, Pl. 8, fig. 8.)
313	June, 1873	" "	Chaetetes sp. ?	Indefinite	Finn's Glen, Minneapolis..	Trenton	N. H. Winchell. (Probably not a Cha-
314	Oct. 1873	" "	Productus?.....	1	Spring Valley.....	Galena ?.....	" [etetes.)
315	"	" "		1	" "	"	"
316	"	" "		1	" "	Niagara.....	"
317	"	" "		1	" "	"	"
318	"	" "	Petraia corniculum. Hall.....	1	Minneapolis.....	Trenton	"
319	"	" "	Petraia? sp.?	1	"	"	"
320	"	" "	Edmondia ventricosa. Hall.....	4	"	"	"
321	"	" "		6	"	"	"
322	"	" "		3	"	"	"
323	"	" "		3	"	"	"
324	"	" "		5	"	"	"
325	"	" "		1	"	"	"

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When	Obtained. Whence.	Name.	Number of Specimens.	Locality.	Formation.	Collector and Remarks.
326	1876.	Geol. Surv...		2	Minneapolis	Trenton...	N. H. Winchell.
327	"	" " ..		2	"	" ..	"
328	"	" " ..	Atrypa. ?.....(v. 220).....	1	"	" ..	"
329	"	" " ..		1	Spring Valley		J. Kleckler.
330	1873.	" " ..	Chaetetes Lycoperdon. Hall.....	Indefinite.	Finn's Glen, Minneapolis	" ..	N. H. Winchell.
331	"	" " ..		6	" "	" ..	"
332	"	" " ..	Murchisonia bicincta. Hall.....	1	" "	" ..	"
333	"	" " ..	Pleurotomaria subconica. Hall.....	1	" "	" ..	"
334	"	" " ..		4	" "	" ..	"
335	"	" " ..		1	" "	" ..	"
336	"	" " ..		3	" "	" ..	"
337	"	" " ..	Bellerophon bilobatus. Sow.....	2	" "	" ..	"
338	"	" " ..	Endoceras magniventrum. Hall	2	Rochester, Olmsted Co.....	" ..	N. H. Winchell, Whitcomb's Quarry.
339	1872.	" " ..		11	" "	" ..	N. H. Winchell, Whitcomb's Quarry.
340	"	" " ..	Isotelus gigas. Hall. Asaphus platycephalus. Stokes.....	1	" "	" ..	N. H. Winchell, Whitcomb's Quarry.
341	"	" " ..	Murchisonia bellicincta. Hall.....	1	Pettit's Mill, Mantorville.....	" ..	N. H. Winchell.
342	"	" " ..	Chaetetes petropolitanus. Pander.....	3	" "	" ..	"
343	"	" " ..	Murchisonia subfusiformis. Hall ?.....	1	" "	" ..	"
344	"	" " ..	Receptaculites occidentalis. Salter ?.....	2	Sec. 16, Pleasant Grove, Olm. Co	" ..	"
345	"	" " ..	Strophomena filitexta. Hall. (Dorsal valve)....	1	" " "	" ..	" as described by Billings (i. e. changing the name of the valve.)
346	"	" " ..		2	Rochester, Olmsted Co.....	" ..	N. H. Winchell.
347	"	" " ..		1	Sec. 16, Pleasant Grove, Olm. Co	" ..	"
348	"	" " ..		2	" " "	" ..	"
349	"	" " ..	Murchisonia bicincta. Hall.....	1	" " "	" ..	"
350	"	" " ..		2	" " "	" ..	"

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Serial No.	Obtained. When.	Obtained. Whence.	Name.	Number of Specimens.	Locality.	Formation.	Collector and Remarks.
351	Oct. 1872	Geol. Surv.		2	Pettit's Mill	Trenton	N. H. Winchell.
352	"	" "		1	Pleasant Grove	"	"
353	"	" "	Strophomena deltoidea. Con	1	St. Anthony	"	"
354	"	" "	Pleurotomaria umbilicata. Hall	1	Rochester, Olmsted Co	"	"
355	"	" "	Murchisonia bicincta. Hall	1	"	"	"
356	"	" "		3	Pleasant Grove	"	"
357	"	" "	Chaetetes Lycoperdon. Hall(or stenopora fibrosa. Gold.)	4	Pettit's Mill	"	"
358	"	" "	Slabs of Trenton (fossiliferous)	10	" "	"	"
359	"	" "	Receptaculites Oweni. Hall	4	Near Rochester, Olmsted Co.	Galena	"
360	"	" "	Has the same as 371, which may not be Strophomena	1	" " "	"	"
361	"	" "	Ambonychia bellistriata. Hall?	1	" " "	Trenton	"
362	"	" "		1	" " "	Galena	"
363	"	" "	Murchisonia bellicincta. Hall	1	" " "	"	"
364	"	" "	Petraia corniculum. Hall	1	" " "	"	"
365	"	" "		1	" " "	"	"
366	"	" "	Ambonychia?	1	" " "	"	"
367	"	" "	Isotelus gigas. DeKay. (Caudal shield.)	1	" " "	"	"
368	"	" "	Endoceras magniventrum. Hall	1	" " "	"	"
369	"	" "	Strophomena fluctuosa Bill	1	" " "	"	"
370	"	" "	Rhynchonella capax. Con	3	Finn's Glen, Minneapolis	Trenton	"
371	"	" "	Strophomena (tenuistriata? v. No. 204.)	1	Near Rochester, Olmsted Co.	Galena	"
372	"	" "	" "	1	" " "	"	"
373	"	" "	" "	1	" " "	"	"
374	"	" "	Orthis testudinaria. Dal	12	St. Charles	Trenton	"
375			Orthis testudinaria. Dal. Strophomena deltoidea. Con. Asaphus platycephalus. Rhynchonella bisulcata. Hall.	1	" "	"	"

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Serial No.	Obtained. When.	Obtained. Whence.	Name.	Number of Specimens.	Locality.	Formation.	Collector and Remarks.
376	Oct. 1872	Geol. Surv		1	St. Charles	Trenton	N. H. Winchell.
377	" "	" "		1	"	"	" "
378	" "	" "	Strophomena deltoidea. Con	1	"	"	" "
379	" "	" "		1	"	"	" "
380	" "	" "	Atrypa reticularis	1	"	"	" "
381	" "	" "		1	" ?	"	" "
382	" "	" "		1	"	"	" "
383	" "	" "	Strophomena (sp. unidentifiable)(v. 391.) Graptolithus, Lingula. Strophomena, Orthis	3	"	"	" " Cast of the interior of the convex valve.
384	" "	" "	Orthoceras? and Pentremites.? (v. Fauna Silurienne. p. 106, fig. 60)	1	Mantorville	Galena	" "
385	" "	" "	Strophomena alternata. Con	1	"	"	" "
386	" "	" "	Graptolithus. sp. nov	1	"	"	" " may be alternistriata. Hall.
387	" "	" "	Strophomena sp.?	1	"	"	" "
388	" "	" "	Fragment of trilobite shield?	1	"	"	" " cast of the interior of convex valve.
389	" "	" "	Strophomena sp.?	1	"	"	" "
390	" "	" "		1	"	"	" "
391	" "	" "	Strophomena (sp. unidentifiable) (v. 383)	1	"	Trenton	" "
392	" "	" "		1	"	Galena	" "
393	" "	" "	Lingula sp.?	1	"	Trenton	" "
394	" "	" "	Strophomena sp.?	1	"	"	" "
395	" "	" "		1		Galena	" "
396	" 1875	" "	Orthis subquadrata. Hall	1	Minneapolis	Trenton	" "
397	" 1871?	" "	Ammonites communis	1	Spring Valley	Galena	" "
398	" " ?	Dr. Stoneman	Orthoceras bilineatum. Hall	1	Paris Basin. Fr	Tertiary	
399	" 1872	W. D. Hurlburt	Caudal extremity of trilobite	1	Minneapolis	Trenton?	Records doubtful
400	" "	" "	Stenopora petropolitana. Pander. Or Chaetetes Lycoperdon. Hall. or Chaetetes petropolitanus. M. & W	1	Trenton Falls, N. Y.	"	" "

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Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
401	1874.....	W. W. McNair.....	Cinnebar ore	1	California		From the New Almaden Mines.
402	Oct. 28, 1872	J. W. Pomeroy	Native Copper.....	3		?	Probably from Lake Superior Mines.
403	" "	"	Copper Scoria	1			" " "
404	Jan. 10, 1873	J. Clarence Bryant.	Fern Leaves.....	3	Illinois Coal Measures.	Coal Meas.	
405		G. D. B. Bainbridge	Talc. (Soapstone.).....	1			
406	1872	S. D. Haskin.....	Straparollus Minnesotensis. (Pl. II, figs. 12 & 13.) (v. Pal. N. Y., I, Pl. 8, fig. 1.).....	1	[dan Sandstone. Traverse Des Sioux, Jor-	Jordan	32 feet from surface of ground, 20 feet from [top of rock.
407	Jan. 6, 1875.	Burdett Thayer...	Large Crystal of Quartz.....	1			
408	Oct. 1872....	Geological Survey.	Pseudomorph after Pyrites.....	1	Winona.....	L. Mag.....	N. H. Winchell.
409	" ...	" "	Orthoceras junceum. Hall	1	St. Charles.....	Trenton ...	"
410	"	" "		1	"		"
411	Sept. 1875...	W. D. Hurlburt....	Isotelus gigas. Hall. (Cast.) Asaphus.	1		Trenton ...	M. W. Harrington.
412	Oct. " ...	Geological Survey.	Galena	1	Near Rochester.....	Galena	Found on the surface.
413	" " ...	" "	Surface bog-ore.....	1	" Mantorville.....		" "
414	Sept. " ...	" "	Asaphus. sp. ? (Or Bathyurus.)....	1	Rochester	Trenton....	Presented by W. D. Hurlburt.
415	Oct. " ...	" "	Siliceous iron ore	1	4 ms. N.W. Cannon Falls	Potsdam...	N. H. Winchell. (At Valentine's. See Andreas' Map.)
416	Jan. 8, 1875..	James Hinton.....	" " [tion.	1	Quincy, Olmsted Co....	" ...	Obtained as a boulder at Quincy. It is magnetic and is known as "Loadstone."
417	July, 1873...	Geological Survey.	Cretaceous sandstone, with vegeta-	1	8 miles below New Ulm.	Cretaceous.	Fritz' quarry. Left branch of Minn. R.
418	Aug. 1876...	" "	Siliceous iron ore	4	4 miles w. Cannon Falls	Potsdam...	N. H. Winchell. (At Valentine's. See Andreas' Map.)
419	Oct. 1872....	" "	Isotelus gigas. Hall. (Cast.).....	1	Mantorville	Galena	Presented by Frank Wilson.
420	"	" "	Receptaculites ?	1	Near Rochester.....	"	N. H. Winchell.
421	"	" "	Isotelus gigas. Hall.....	1	" "	"	" "
422	" ...	" "	(Cast)	1	Mantorville	"	Presented by Frank Wilson.
423	"	" "		1	Near Rochester	"	N. H. Winchell.
424	Apr. 1876...	J. A. Armstrong...	Mountain Bank (Penn.) soft coal....	1		Coal Meas.	"
425	" ...	" ...	Briar Hill (Ohio) soft coal.....	1		"	"

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Serial No.	Obtained. When.	Obtained. Whence.	Name.	Number of Specimens.	Locality.	Formation.	Collector and Remarks.
426	April 1876	A. J. Armstrong.....	Anthracite, Penn. Hard coal.....	1	Lehigh, Penn.....	Coal Meas.	N. H. Winchell.
427	" "	" "	Canton Shaft, Illinois. Soft coal...	1	Canton, Ill.	"	"
428	Oct. 1875	Geol. Surv.	Atrypa ?.	13	Spring Valley	Galena ?...	"
429	" "	" "	Orthis occidentalis. Hall.....	1	" "	Galena.....	"
430	" "	" "	Strophomena fluctuosa. Bill.....	5	" "	"	The specimens are smaller than stated by Billings. (Pal. Fos. p. 124.)
431	Sept. 1875	" "	Murchisonia bicincta. Hall ?.....	1	Mantorville.....	"	M. W. Harrington.
432	Oct. 1872	" "	Rhaphistoma lapicida. Salter ?....	2	Rochester, Olmsted Co.	Trenton....	N. H. Winchell
433	" 1875	" "		2	Chatfield, Fillmore Co.	"	"
434	" 1872	" "	Orthis testudinaria. Dal. Orthoceras, Strophomena deltoidea. Con. Cyrtoceras. Rhaphistoma lapicida. Sal.? Murchisonia. Isotelus gigas. Hall. Licahas sp. ? ...	1	Rochester, Olmsted Co.	"	" (Slab.)
435	" "	" "	Strophomena deltoidea. Con. Orthis testudinaria. Dal. Asaphus platycephalus. Lichas. ? Lingula quadrata. Eich	1	" "	"	" "
436	" "	" "	Atrypa recurvirostra. Hall	5	St.Charles, Winona Co.	"	"
437	" "	" "		...			
438	" "	" "	Rhynchonella bisulcata. Hall.....	1	" "	"	"
439	" "	" "	Rhynchonella capax. Con.....	1	" "	"	"
440	" "	" "	Slab with Rhynchonella, Orthis and Strophomena.....	1	" "	"	"
441	Nov. 1876	Centennial Exhibition.	Cannel Coal.....	1	Greenup Co., Ky.....	Coal Meas..	N. H. Winchell, from the Kentucky Survey.
442	" "	" "	Itacolumite	1	Mariposa Co., Cal.....		" Purchased of A. E. Foot.
443	" "	" "	Beryl.....	1	Ackworth, N. H.....		" " "
444	" "	" "	Crystalized Brown Haematite.....	4	Stewart Co., W. Tenn..		" From Tenn. Commissioners
445	" "	" "	" " "	1	Brierfield, Ala.....		" From S. W. Baird.
446	" "	" "	Haematite.....	4	———Kentucky.....		" From Kentucky Survey.
447	" "	" "	Magnetic Oxide of Iron.....	7	Port Henry, N. Y.....		"
448	" "	" "	Ochreous Brown Haematite	1	———Pennsyvania...		" From Penn. Commissioners
449	" "	" "	Crystals of Franklinite.....	1	Franklin, N. Y.....		" Purchased of Gee. Kunz.
450	" "	" "	Sulphate of Strontia.....	1	Ontario.....		" Fom Geol. Surv. of Canada.

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
451	Oct. 1876	Cent. Exp.	Apatite	1	Bedford, Ontario		N. H. Winchell, Geol. Surv. of Canada.
452	"	"	Carbonate of Zinc	1	Union Co., Tenn		" Tenn. Commissioners.
453	"	"	Albertite	3	Albert Co., N. B.		" { Geol. Surv. of Canada. { P. 57, Canada Catalogue.
454	"	"	"	Indefi	Canada		" Geol. Surv. of Canada.
455	"	"	Sapphire	1	Near Franklin, N. J.		" Purchased of Geo. F. Kunz.
456	"	"	Antimony Ore	1	Prince William, N. B.		" Geol. Surv. of Canada.
457	"	"	Spathic Iron Ore	1	Sutherland's R., N. S.		" " "
458	"	"	Gmelinite, Natrolite and Datholite	1	Bergen Hill, N. J.		" Purchased of Geo. F. Kunz.
459	"	"	Magnetite	1	Crosby, Ont.		" Geol. Surv. of Canada.
460	"	"	Fluor Spar coated with Pyrites	1	Thunder B., B A		" Purchased of A. E. Foote.
461	"	"	Copper Pyrites in micaceous sandstone.	2	Alleghany Co., N. C.		"
462	"	"	Coal. (Said to be nearly pure carbon)	1	Poplar Creek, E. Tenn		" 7 ft. thick.
463	"	"	Magnetite	3	New Bed Mine, Port Henry, N.Y.		"
464	"	"	Semi-Anthracite Coal	1	Rockwood, Tenn.		" 104 ft. thick.
465	"	"	Ankerite (ferriferous dolomite)	1	Canada		" Geol. Surv. of Canada.
466	"	"	Brier Hill Coal	2	Ohio		"
467	"	"	Quartz Crystals	4	Herkimer Co., N. Y.	Calciferous	Purchased of Geo. F. Kunz.
468	"	Geol. Surv.	Crag	1	Banks of Crow R., Hennepin Co.	Drift	N. H. Winchell.
469	"	Cent. Exp.	Haematite and Magnetite	1	Hull, Ottawa		Geol. Surv. of Canada.
470	"	"	Sulp. Baryta	1	Two Islands, N. S		" "
471	"	"	Dolomite, with crystals of Magnetite and carb. of Manganese	1	Sutton, Quebec		" "
472	"	"	Sussexite (containing Magnesia.)	1	Franklin, N. J.		Geo. F. Kunz.
473	"	"	Amazon Stone (smaller crystals)	5	Pike's Peak, Col.		Purchased of A. E. Foote.
474	"	"	Spinel	1	{ Orange Co., N. Y. { Harvey Hill Mine		" "
475	"	"	Veined Copper Ore	2			Geol. Surv. of Canada. { See p. 29, No. 10. { a. & b. Canada Cat.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Colle
476	Nov. 1876	Centen'l Exposition.	Chromic Iron ore	1	Bolton, Quebec		Geol. Surv
477	"	" "	Crysoprase. (Cut.)	1	S. Park, Col		A. E. Foot
478	"	" "	Agate. (Cut.)	2	" "		" "
479	"	" "	Black Agate. (Cut.)	1	" "		" "
480	"	" "	Moss Agate. (Cut.)	2	" "		" "
481	"	" "	Cuprite on Copper	1	England		" "
482	"	" "	Native Copper	1	Lake Superior		" "
483	"	" "	Embolite	1	Silver City, N. Mexico		" "
484	"	" "	Rutile	1	Georgia		" "
485	"	" "	Celestite and Sulphur	1	Sicily		" "
486	"	" "	Orthoclase. Amazon Stone	3	Pike's Peak, Col		" "
487	"	" "	Milky Quartz	1	Lake Superior		" "
488	"	" "	Ruby	3	Near Franklin, N. J		Geo. F. K
489	"	" "	Amethyst	1	Amethyst Harbor, L. Sup		N. H. Win
490	"	" "	Calymene Senaria. (Trilobite.)	1	Warren Co., Ohio		A. E. Foot
491	"	" "	Azurite	1	Chesse, France		" "
492	"	" "	Bornite	1	Mt. Catine, Tuscany		" "
493	"	" "	Smoky Quartz, Cairngorm Stone and Smoky Topaz	1	Pike's Peak, Col		" "
494	"	" "	Saponite, *var.* Agalmatalite	1	Cherokee Co., N. C		" "
495	"	" "	Wavellite	1	Montgomery Co., Ark		" "
496	"	" "	Fossiliferous Iron ore	2	Pilot Knob, McMun Co., E. Tenn		Gen. Wild
497	"	" "	Magnetite	1	Chattanooga, Tenn		" "
498	"	" "	Brown Haematite	7	" "		" "
499	1875	Prof. Laing	Sulphuret of Copper	1	Bolton, Quebec		
500	"	"	Plumbago	1	Canada West		

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
501	1875	Prof. Laing	Asbestos		South Stokely, Quebec		
502	"	"	Concretions	3	N. W. Iowa		
503	"	"	Galena ore	1	Galena, Ill.		
504	"	"	Calcite	1	Brompton, Quebec.		
505	"	"	Copper (native)	3	Lake Superior		
506	"	"	Coral	1			
507	"	"	"	1			
508	"	"	"	2			
509	"	"	"	1			
510	"	"	Chaetetes sp.? Coral	1			
511	"	"	Petraia sp.? "	1			
512	"	"	Coral	1			
513	"	"	Pleurotomaria umbilicata. Hall	1			
514	"	"	Fragment of a crinoid stem	1			
515	"	"	Spirifer sp.?	1			
516	"	"	Fragment of a crustacean	1			
517	"	"	Iron ores	4			
518	"	"		1			
519	"	"	Volcanic products	2	Sandwich Islands		
520	1871	D. A. Roe	Greenstone, veined with epidote	1	St. Croix Falls	Igneous	D. A. Roe.
521	"	"	Porphyritic Greenstone	1	" "	"	D. A. Roe.
522	"	"	Porphyry (Red crystals of Feldspar)	2	" "	"	"
523	"	"	Epidotic Rock	1	" "	"	"
524	"	"	Greenstone	1	" "	"	"
525	1873	I. J. Rochussen	Cathnite (cut in form of a book)	1	Pipestone Quarry	Potsdam	"

Serial No.	Obtained.		Name	No. of Specimens.	Locality.	Formation.	Collector and I
	When.	Whence.					
526	1871 ?	?	Claystones	10	Massachusetts		?
527	"	?	Drusy Quartz	1	?		?
528	1873	Geol. Surv	Quartzite polished by blown sand	3	Pipestone Co., Minn	Potsdam	I. J. Rochussen.
529	1871 ?	?	Geode with Chalcadony lining	2	Keokuk, Iowa	Sub. Carb	?
530	1873	Geol. Surv	Quartzite. (Red)	1	Pipestone Co., Minn	Potsdam	I. J. Rochussen.
531	1871 ?	?	Geode lined with quartz crystals	1	Brown Co., Ill	Sub. Carb	?
532	"	?	Carb. Lime. Stalactitic.	7	Dubuque, Iowa	Galena	?
533	"	D. A. Roe	Wulfenite. (Molybdate of lead)	1	Southampton, Mass		
534	"	?	Albite	1	Mass		No records.
535	"	?	Pyritiferous mica schist ?	1	New Hampshire		"
536	"	?	Actinolite	1	Mass		
537	1876	Minneapolis boulder.	Labradorite	4	Minneapolis	Drift	N. H. Winchell.
538	1871 ?	?	Hornblende	1	Chester, Mass		?
539	"	?	Micaceous feldspar.	1	?		?
540	"	?	Chrysocolla	2	Arizona		?
541	"	?	Beryl	1	Ackworth, N. H		?
542	"	?	Tremolite (or Calamite)	1	Canaan, Conn		?
543	"	?	Andalusite (Macle)	5	?		? See p. 371, No. 323.
544	"	?	Titanite (or yellow sphene)	1	Williams Bridge, N. Y		?
545	"	?	Topaz	5	Brazil, S. A		?
546	"	?	Kyanite	2	New Hampshire		?
547	"	?	Tourmaline	1	New York		?
548	"	?	Crag	1	?		?
549	"	?	Tourmaline	2	Ackworth, N. H		? M
550	"	?	Amanthus	4	?		?

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.
551	1871 ?.....	Prof. Beardsley..	Hornblende. (Amphibole.).....	1
552	"	?	Amphibole. (Asbestos.).....	1
553	"	?	Chabazite.	1
554	"	?	Muscovite.....	2
555	"	Prof. Beardsley..	Serpentine.....	1
556	March, 1876	Univ. Laboratory	Delessite	1
557	1871 ?.....	?	Talc.....	1
558	"	?	Garnet, Muscovite and Quartz.....	1
559	"		Steatite. (Soapstone.).....	3
560	"	D. A. Roe.....	Apatite.....	1
561	"	?	Native Sulphur.....	1
562	"	?	Graphite.....	3
563	"	D. A. Roe.....	Molybdenite.....	1
564	"	?	Sphalenite. (Zinc-blende.).....	1
565	"	?	Sphalenite. (Zinc-blende.).....	1
566	"	?	Fluorite.....	2
567	1876.....	W. E. Leonard...	Sal Ammoniac.....	1
568	1871 ?.....	D. A. Roe.....	Zincite and Franklinite.....	1
569	"	?	Rose Quartz.....	1
570	"	?	Haematite. (And specula iron.).....	1
571	Feb. 1872,..	Dr. McMasters..	Itacolumite	1
572	1873	I. J. Rochussen..	Conglomerate	1
573	1874.....	Geol. Surv.....	Agatized wood.....	1
574	1871.....	?	Sandstone.....	1
575	1871.....	?	Barite	1

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 1, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	Number of Specimens.	Locality.	Formation.	Collector and Remarks.
576	1875.....	N. H. Winchell...	Gypsum.....	2	Grand Rapids.....	Carb.....	? (Cut)
577	1871?.....	?	Satin Spar. (Selenite.).....	1	?		?
578	1874.....	N. H. Winchell..	Calcite—Fibrous, dark.....	1	Dakota	Cretac.....	N. H. Winchell.
579	1871?.....	?	Geode with lining of Calcite.....	Fragmen'ts.	Brown Co., Ill.....	Carb	?
580	"	?	Cannel Coal.....	3	Fort Dodge, Iowa....	"	?
581	"	?	Magnetite	2	Pilot Knob, Mo.....		?
582	"	?	"Diaspore, white. Rutile, red. Biotite, laminated, (also iron and emery.").....	1	Mass.....		?
583	1876.....	Cent'l Exposition	Gothite	1	Pike's Peak, Col.....		A. E. Foote. (Dealer.)
584	Oct. 1875...	Geol. Surv.....	Red Granite.....	1	St. Cloud, Minn.		N. H. Winchell.
585	1871?.....	?	Brown Haematite.....	1	?		?
586	1873.....	Geol. Surv.....	Catinite..	1	Pipestone Co., Minn.	Potsdam...	I. J. Rochussen.
587	1871?.....	?	Malachite.....	1	Plattville, Wis.....		?
588	"	?	Tourmaline. (black)	1	Ackworth, N. H.....		?
589	1874.....	Geol. Surv.....	Phonolyte.....	1	Bear Butte, Dakota..	Igneous....	N. H. Winchell.
590	1871?.....	?	Agate. (Cut.).....	1	Brazil, S. A.....		?
591	"	?	Quartz and Tourmaline.....	1	Ackworth, N. H.....		?
592	1872.....	Geol. Surv.....	Honestone. (Sawed.).....	1	Austin, Minn.....	Cretaceous.	N. H. Winchell.
593	Mar. 7, 1876	" "	Barite coated with limonite after pyrite.....	1	Missouri.....		
594	Nov. 1872..	" "	Ripple marked slab of red sandstone.....	2	New Ulm, Minn.. ...	Potsdam...	N. H. Winchell.
595	1871?.....	?	Geode with lining of calc spar.....	1	Keokuk, Iowa.....	Carb.....	
596	"	D. A. Roe.....	Greenstone porphyritic with feldspar and epidote.....	1	St. Croix Falls, Minn.	Igneous....	D. A. Roe.
597	"	?	Pyrite, Galenite and calcite, on siliceous slate.	1	?		?
598	1873.....	Geol. Surv. (Manufacturers.)	Fire Brick.	1	New Ulm, Minn.....		N. H. Winchell.
599	Feb. 21, 1876	W. D. Hurlburt..	Cuprite and Malachite on Native Copper.....	1	Rochester, "	Drift... ...	On the bench of the Shakopee limestone other pieces weighed 6 pounds each.
600	Nov. 1876..	Cent'l Exposition	Brookite. (Crystals.).....	5	Magnet Cove, Ark...		A. E. Foote.

Catalogue of the Geological and Mineralogical Specimens of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
601	Nov. 1876..	Centennial Exposition.	Staurolite crystals	2	Mink Point, N. H		A. E. Foote.
602	" ..	" "	Fluorite "	1	Cumberland, Eng		"
603	" ..	" "	Siderite on Fluorite crystals	1	"		"
604	" ..	" "	Chrysocolla	1	Mammoth Cave, Utah		"
605	" ..	" "	"Hallite" "	3	Near Chester, Mass		"
606	" ..	" "	Tourmaline "	1	Warwick, Mass		"
607	" ..	" "	Manganite "	1	Ilefeld, Hartz Mts		"
608	" ..	" "	Celestite	1	Pt. aux Peaux, Mich		"
609	" ..	" "	Picrolite (serpentine)	1	Bohemia		"
610	" ..	" "	Penninite	1	Lancaster Co., Penn		"
611	" ..	" "	Baltimorite (serpentine)	1	Texas, "		"
612	" ..	" "	Celestite	1	Ft. Dodge, Iowa		"
613	" ..	" "	Stilbite (crystals)	1	Nova Scotia		"
614	" ..	" "	Perofskite "	4	Magnet Cove, Ark		"
615	" ..	" "	Scolecite (zeolite)	1	Cape Blomidon, N. S		"
616	" ..	" "	Lazulite (crystals)	1	Grass Mt., Ga		"
617	" ..	" "	Tourmaline	1	Goveneur, N. Y		"
618	1871?.	?	Quartz, mass of crystals	1	?		?
619	Dec.31, 1875	Geo. N. Bennett	Marbleized Slate	1	Hydeville, Vt		Marbleized at Troy, N. Y.
620	1871?	?	Geode, with quartz lining	2	Brown Co., Ill		
621	Dec. 1876 ..	S. F. Peckham.	Bowenite (serpentine)	1	Smithfield, R. I		
622	" ..	"	Vermiculite (Phyroselerite)	1	Milbury, Mass		
623	" ..	"	Metamorphic limerock	1	Rhode Island		Clouded.
624	" ..	"	Garnets in Mica schist	1	Chesterfield, Mass		
625	" ..	"	Lepidolite	1	Paris, Maine		

Catalogue of the Geological and Mineralogical Specimen of the Museum, to December 31, 1876.—Continued.

Serial No.	Obtained. When.	Obtained. Whence.	Name.	No. of Specimens.	Locality.	Formation.	Collector and Remarks.
626	Dec. 1876	S. F. Peckham	"Gothite." (Haematite mostly)	1	Michigan Mine, Marquette, Mich.	Huronian	
627	" "	"	Phorphyritic iron, containing Titanium	1	Cumberland Hill, R. I		
628	" "	"	Phyllite	1	Cranston, R. I		
629	" "	"	Ripidolite	1	Cumberland Hill, R. I		
630	" "	"	Chalcopyrite	1	" "		
631	" "	"	Orthite (allanite) small, dark crystals. Scapolite (Wernerite) white, main portion. Sphene (Titanite) greenish massive	1	Bolton, Mass		
632	Dec. 1874	"	Slab of slate with impressions of plants	1	{ Portsmouth Mine. { Rhode Island I.	Carb.	
633	?	?	Plumbago	Many	Ticonderoga, N Y		
634	Nov. 1876	Centennial Exposition.	Native sulphur	1	Kilauea, Sandwich Islands		

X.

ORNITHOLOGICAL NOTES.

By C. L. Herrick.

MINNEAPOLIS, Dec., 1876.

Prof. Winchell:

The work represented by the following list of birds was, of course, much impeded by the difficulties incident to the season during which it was prosecuted; for not only are there comparatively few birds, and those of the commonest species to be found during the heated term, but those actually collected are often unfit, on account of the summer moult, for preservation or study.

Yet though the field work was over before the fall migration was fairly commenced, a few facts of some interest were noticed.

From observations made during the summer it would seem that the Brotherly-Love Vireo (*Vireo philadelphicus*) is not as rare as until recently supposed, and, indeed, it may be found to be quite as common in this locality as the *Vireo gilvus*. The vireos collected were shot without discrimination, yet two were quite typical specimens of *philadelphicus*.

The results obtained from the study of the few shrikes as yet collected at Minneapolis are so unexpected and withal so contradictory, that the following remarks are given with some hesitancy, especially as they are at variance with what has been written upon these birds by others who have collected in this State.

The Great Northern Shrike, or *Collurio borealis*, is as yet only noted as occurring during Spring and Fall. I have never heard of the nest in this vicinity. I am led to believe that the bird is somewhat rare, even during the migrations, for in the Spring it is very conspicuous from the habit it has of perching on a high tree and uttering at intervals its peculiar metallic cry on its arrival in any locality; and thus the comparatively small number of specimens collected is more significant.

The smaller shrikes, so abundant here, or many of them, seem to partake of the characteristics of both varieties, viz: *ludovicianus* and *excubitoroides*. The three in the museum seem to me to nearly

accord with the descriptions of *ludovicianus*. They all, together with two in my own collection, have the two inner tail feathers black to the bases; but another, which also possesses several other resemblances to *excubitoroides*, has evident white patches on all the tail quills. Again a number of these birds in the possession of Mr. T. S. Roberts agree in disagreeing with every description of either variety.

I draw from these facts the inference that the variety *ludovicianus* predominates over the other, but that the types are mingled and blended so as to baffle any accurate identification.

The nesting of these birds may be easily observed in many parts of the suburbs, but the nests are often mistaken for those of the more northern Butcher Bird.

Perhaps the Red-bellied Nuthatch may be less rare during migration than supposed, if searched for in suitable localities.

The bird-fauna of the State has received one addition in the tern *Sterna caspia* (Thalassus c. Boie.) This is the largest of the terns, and is a very beautiful and striking bird. The only specimen as yet identified from this State, as far as I am aware, was secured at Long Lake by Will Secombe, of Minneapolis, by whom it was presented to the museum.

The English House-Sparrow was simultaneously observed by Mr. Roberts and myself during the early part of the winter about the streets of the city, and I learn from that observer that they have survived our severe weather as yet.

The fact that birds are often infested by intestinal worms particularly the Tape Worm, (Tænia) has attracted so much notice of late that I mention the collection of a variety of these parasites from the solitary Tattler ; also a quasi-parasitic colony of crustaceans found upon a goose. I received from Mr. Roberts several specimens of crustaceans collected from Hutchins' goose, found deeply imbedded in the feathers near the skin. These proved to be miniature Sand Fleas (fresh water.) Of course it is hardly to be supposed that this was more than an accident. I can not account for this except by supposing it to be the result of the proclivity of these fleas (so often noticed) to wedge themselves in the thick masses of leaves upon the Bladder-wort and other water plants.

AVES.

Note. A star (*) signifies male. A dagger (†) denotes the female.

TURDIDÆ.

1. Harpochynchus rufus. Cab. Brown Thrush. Minneapolis, Aug. 20th, 1876. (69.)
2. Mimus carolinensis. Cab. Cat Bird.* Minneapolis, May 14th, 1875. (26.)

SITTIDÆ.

3. Sitta carolinensis. Gm. White-Bellied Nuthatch * Minneapolis, Aug. 12th, 1876. (64.)
4. Sitta carolinensis, Gm. White-Bellied Nuthatch. Minneapolis, July 24th, 1876. (65.)
5. Sitta canadensis, L. Red-Bellied Nuthatch. Minneapolis, Aug. 16th, 1876. (66.) *Not common.*

SYLVICOLIDÆ.

6. Mniotilla varia. Vieill. Black and White Creeper.* Minneapolis, Aug. 16th, 1876. (10.)
7. Mniotilla varia. Vieill. Black and White Creeper. Minneapolis, Aug. 18th, 1876. (77.)
8. Dendrœea æstiva. Bd. Golden Warbler. Minneapolis, May 7th, 1875. (6.)
9. Dendrœea æstiva. Bd. Golden Warbler.* Minneapolis, Aug. 16th, 1876. (7.)
10. Dendrœea æstiva. Bd. Golden Warbler.* Minneapolis, Aug. 14th, 1876. (8.)
11. Dendrœea coronata. Gray. Yellow-Rumped Warbler.† Minneapolis, May 15th, 1875. (9.)
12. Mniotilla varia. Vieill. Black and White Creeper. Minneapolis, Aug. 18th, 1876. (76.)
13. Seiurus aurocapillus. Sw. Golden-Crowned Thrush.* Minneapolis, Aug. 20th, 1876. (79.)
14. Seiurus aurocapillus. Sw. Golden-Crowned Thrush. Minneapolis, May 15th, 1875. (4.)
15. Seiurus novembraeinsis. Nutt. Water Thrush. Lake Minnetonka, Aug. 14th, 1876. (5.)
16. Setophaga ruticilla. Sw. Red Start.* Minneapolis, Aug. 20th, 1876. (80.)
17. Setophaga ruticilla. Sw. Red Start.* Minneapolis, Aug. 20th, 1876. (81.)
18. Setophaga ruticilla. Sw. Red Start. Minneapolis, Aug. 15th. (15.)

TANAGRIDÆ.

19. Pyranga rubra. Vieill. Scarlet Tanager.* Minneapolis, July 19th, 1876. (28.)

HIRUNDINIDÆ.

20. Cotyle riparia. Boie. Bank Swallow.* Minneapolis, Aug. 14th, 1876. (47.)

AMPELIDÆ.

21. Ampelis cedrorum. Bd. Cedar Bird.* Minneapolis, July, 1876. (25.)

VIREODINÆ.

22. Vireo olivacea. L. Red-eyed Vireo.* Minneapolis, July 19th, 1876. (11.)
23. Vireo philidelphica. Cassin. Philidelphia Vireo. Minneapolis, Aug. 1876. (14.)
24. Vireo philidelphica. Cassin. Philidelphia Vireo. Minneapolis, Aug. 20th, 1876. (78.)
25. Vireo gilva. Cass. Warbling Vireo.* Minneapolis, July 11th, 1876. (12.)
26. Vireo flavifrons. Bd. Yellow-throated Vireo.* Minneapolis, Aug. 16th, 1876. (13.)

LANIDÆ.

27. Collurio ludivicianus. Bd. Loggerhead Shrike.* Minneapolis, Aug., 1876. (7.)
28. Collurio ludivicianus. Bd. Loggerhead Shrike.† Minneapolis, July 20th, 1876. (2.)
29. Collurio ludivicianus. Bd. Loggerhead Shrike. Minneapolis, 1875. (3.)

FRINGILLIDÆ.

30. Chrysomitris tristis. Bon. Yellow Bird.† Minneapolis, Nov. 26th, 1875. (31.)
31. Chrysomitris tristis. Bon. Yellow Bird.* Champlin, Minn., June 18th, 1875. (30.)
32. Plectrophanes niralis. Meyer. Snow Bunting.* Minneapolis, Nov. 30th, 1876. (88.)
33. Plectrophanes niralis. Meyer. Snow Bunting.† Minneapolis, Nov. 30th, 1876. (89.)
34. Pœcetes gramineus. Bd. Grass Finch. Minneapolis, Aug. 16th, 1876. (35.)
35. Pœcetes gramineus. Bd. Grass Finch. Minneapolis, Aug. 1876. (36.)
36. Spizella socialis. Bon. Chipping Sparrow.* Minneapolis, Aug. 14th, 1876. (32.)
37. Spizella monticolor. Bd. Tree Sparrow.* Minneapolis, Oct. 9th, 1876. (84.)
38. Spizella pallida. Bon. Clay-Colored Bunting.* Minneapolis, Aug., 1876. (33.)
39. Spizella pallida. Bon. Clay-Colored Bunting.† Minneapolis, May 7th, 1875. (34.)
40. Chondestes grammaca. Bon. Lark Finch. Minneapolis, 1875. (38.)
41. Melospiza melodia. Bd. Song Sparrow.* Minneapolis, Aug. 12th, 1876. (37.)

42. Goniaphea ludiviciana. Bowdich. Rose-Breasted Grosbeak.* Minneapolis, June, 1875. (27.)
43. Goniaphea ludiviciana. Bow. Rose-Breasted Grosbeak. Minneapolis, Aug. 18th, 1876. (75.)
44. Cyanospiza cyanea. Bd. Indigo Bird.* Minneapolis, July, 1876. (29.)
45. Pipilo crythrophthalmus. Vieill. Chewink.* Minneapolis, Aug. 3d, 1876. (39.)
46. Junco hyemalis. Sd. Snow Bird.* Minneapolis, Oct. 9th, 1876. (83.)

Ieteridæ.

47. Dolichonyx oryzivorus. Sw. Bobolink.* Minneapolis, July 20th, 1876. (42.)
48. Agelæus phœnicus. V. Red-Winged Black Bird.* Minneapolis, Aug. 4th, 1876. (41.)
49. Sturnella magna. Sw. Meadow Lark.* Minneapolis, July 18th, 1876. (40.)
50. Ieterus baltimore. Daudin. Baltimore Oriole.* Minneapolis, May 22d, 1875. (21.)
51. Ieterus spurius. Bon. Orchard Oriole.* Minneapolis, 1875. (22.)
52. Ieterus spurius. Bon. Orchard Oriole.* Minneapolis, 1875. *Juv. specimine.* (23.)
53. Ieterus spurius. Bon. Orchard Oriole.† Minneapolis, July, 1876. (24.)

Corvidæ.

54. Corvus corax. L. Raven.* (*Mounted.*) Minneapolis, Oct., 1876. (85.)
Not common.
Presented by N. Herrick, Esq.
55. Cyanurus cristatus. Sw. Blue Jay. Minneapolis, July 20th, 1876. (45.)

Tyrannidæ.

56. Tyrannus carolinensis. Bd. King Bird.* Minneapolis, May 14th, 1875. (20.)
57. Contonops virens. Cab. Wood Pewee.* Minneapolis, Aug. 11th, 1876. (16.)
58. C. virens. Cab. Wood Pewee.* Minneapolis, Aug. 15th, 1876. (17.)
59. C. virens. Cab. Wood Pewee.† Minneapolis, Aug. 15th, 1876. (18.)
60. C. virens. Cab. Wood Pewee. Minneapolis, July, 1876. (19.)

Caprimulgidæ.

61. Chordeiles virginianus. Bon. Night Hawk.* Minneapolis, Aug. 16th, 1876. (44.)

Cypselidæ.

62. Cotyle pelasgio. Bd. Chimney Swift.* Minneapolis, July 10th, 1876. (43.)

Alcedinidæ.

63. Cryle alcyon. Boie. Belted Kingfisher. Minneapolis, Aug. 1st, 1876. (46.)

Picidæ.

64. Picus pubescens. L. Downy Woodpecker.* Minneapolis, July, 1876. (60.)

65. Picus pubescens. L. Downy Woodpecker.* Minneapolis, Aug. 16th, 1876. (61.)
66. Picus pubescens. L. Downy Woodpecker.* Minneapolis, Aug. 20th, 1876. (73.)
67. Melanerpes erythrocephalus. Sw. Red-headed Woodpecker. July 23d, 1876. (62.)
68. Melanerpes erythrocephalus. Sw. Red-headed Woodpecker.* Minneapolis, Aug. 28th. (71.)
69. Colaptes auratus. Sw. Golden-winged Woodpecker. Minneapolis, April 29th, 1875. (63.)
70. Colaptes auratus. Su. Golden-winged Woodpecker.* Minneapolis, Aug. 28th, 1876. (72.)

STRIGIDÆ.

71. Bubo virginianus. Wilk. Great-horned Owl.* Minneapolis, Nov., 1876. (86.) *From Collection of C. L. Herrick.*

FALCONIDÆ.

72. Falco sparverius. L. Sparrow Hawk. Minneapolis, Aug. 2, 1876. (67.)
73. Falco sparverius. L. Sparrow Hawk. Minneapolis, Aug. 13th, 1875. (68.)
74. Buteo borealis. Vieill. Red-tailed Hawk.* Jav. Minneapolis, July, 1876. (82.) (*Mounted.*)

COLUMBIDÆ.

75. Ectopistes migratorius. Sw. Wild Pigeon. Minneapolis, July 11th, 1876. (58.)
76. Ectopistes migratorius. S. Wild Pigeon. Minneapolis, July 11th, 1876. (59.)

TETRAONIDÆ.

77. Bonasa umbellus. Stephens. Ruffed Grouse. Minneapolis, July, 1876. (48.)

CHARADRUDÆ.

78. Ægialitis vociferus. Cass. Killdeer Plover.† Minneapolis, July 22d, 1876. (57.)

SCOLOPACIDÆ.

79. Totanus solitarius. Wilson. Solitary Tattler.* Minneapolis, Aug. 17th, 1876. (55.)
80. Totanus solitarius. Wils. Solitary Tattler.* Minneapolis, Aug. 12th, 1876. (56.)
81. Totanus solitarius. Wils. Solitary Tattler. Minneapolis, Aug. 20th, 1876. (74.)
82. Tringoides macularius. Gray. Spotted Sandpiper. Minneapolis, Aug. 4th, 1876. (53.)
83. Tringoides macularius. Gray. Spotted Sandpiper.* Minneapolis, July 14th, 1876. (54.)
84. Actiturus bartramius. Bon. Upland Plover. Minneapolis, Aug. 6th, 1875. (52.)

ARDEIDÆ.

85. Botaurus mugitans. Coues. Bittern. Minneapolis, 1875. (49.)

RALLIDÆ.

86. Porzana carolina. V. Carolina Rail.† Minneapolis, Aug. 20th, 1876. (70.)

LARIDÆ.

87. Sterna caspia. Pall. Caspian Tern. Long Lake, Nov., 1876. (87.)
Rare.
Collected and presented by Will. Secombe.
88. Hydrochelidon lariformis. Coues. Black Tern. Minneapolis, July 19th, 1876. (50.)
89. Hydrochelidon lariformis. Coues. Black Tern, *young*. Minneapolis, July 19th, 1876. (51.)

ANATIDÆ.

90. Bucephala clangula. Wils. Golden-Eye. Garrot. Minneapolis, Jan. 17th, 1877.

Just as this proof is going to press, I have the pleasure of announcing that I had the good fortune to secure for the collection two specimens of Le contes Sparrow, *coturniculus lecontei*, thus adding this to the very few localities of its occurrence. A more extended notice will doubtless be given hereafter.

XI.

A NEW CYCLOPS.

By C. L. Herrick.

Cyclops quadricornis has often been used as an object for study by those desirous of becoming familiar with the process of development in crustacea. For this it is eminently fitted both on account of its very distinct changes and its abundance in every pond and pool.

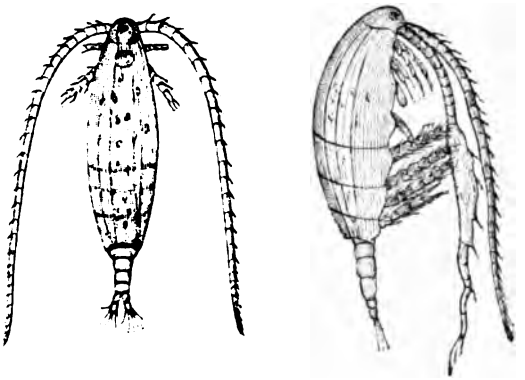


Fig. 1.

There is another member of the same genus which has not, apparently, been described, and I have therefore provisionally named it *C. longicornis* from the very long primary antennæ.

The appearance of an ordinary individual (*Fig.* 1.) is not very widely different from the ordinary species. But the first glance of the female with the spherical sac of ova under the abdomen makes the creature seem quite distinct.

The general appearance and its movements while swimming briskly about cause it to look like a magnified cladocera, the long spreading antennæ increasing the similarity. The glass at once dispels the illusion however.

The eggs are larger in proportion than those of *quadricornis* and

are loosely aggregated beneath the abdomen The cephalothorax is very large and carries the usual complement of motory appendages. The first antennæ are long—exceeding the body. The second pair are specialized enough to be called antennæ, and the claws are, according to my observation, small though they were indistinctly seen.

The abdomen is in proportion smaller than in *quadricornis*, and the tail similar to that of a young of that species. Of internal structure little was made out, but the red glands are as prominent as in the other. A curious case of malformation of antennæ is shown in the figure. The color is transparent white, except the tips of the antennæ and the last segments of the abdomen.

The process of cephalization is well illustrated by the cyclops, though not as aptly as in the larger crustaceans, the Sand Fleas.



Fig. 2.

A recent observation of a number of diatoms dipped from the bottom of the deeper portion of Lake Calhoun, seems to prove that one species is clothed with cilia throughout, and not simply at the ends as usually described. While watching the motions of a Navicula-like plant propelling itself slowly along it was seen to collide with a large mass of vegetable matter, and while thus brought to a stand-still the infinitesimal particles floating near it were seen to traverse its whole length, the diatom and particles beyond reach of its influence remaining motionless in the meantime. This specimen was of sufficient length to preclude the possibility of the cilia at the ends having any influence upon the particles.

Other Collections.

Besides the Moose mentioned in the report of last year, the following mounted mammals are on exhibition:

Antilœapra Americana. Ord. Pronghorn Antelope. 2 male and 2 female. Custer Expedition to the Black Hills. 1874.

Corvus Canadensis. Exl. American Elk. Custer Expedition to the Black Hills. 1874.

Badger. Custer Expedition to the Black Hills. 1874.

Ursus horribilis. Ord. Grizzly Bear, female. Custer Expedition to the Black Hills. 1874.

Corvus lencurus. Doug. White-Tailed Deer; 1 male, 2 females. Cus. Ex. Blk. Hills. 1874.

Rangifer Caribou. And. and Bach. Woodland Caribou (unmounted.) Presented Dec., 1875, by Nathan Butler.

Seiurus hudsonius. Pall. Red Squirrel. Three specimens.

Tamius striatus. Bd. Chipmunk.

Spermophilus tridecemlineatus. Mitch. Striped Gopher.

Hesperomys michiganensis. Wag. Michigan Mouse.

Procyon lotoi. Ston. Common Raccoon.

Reptiles.

Pana catesbiana. Shaw. Bull Frog.

Amblystoma tigrinum. Bd. (Immature.) Common Salamander.

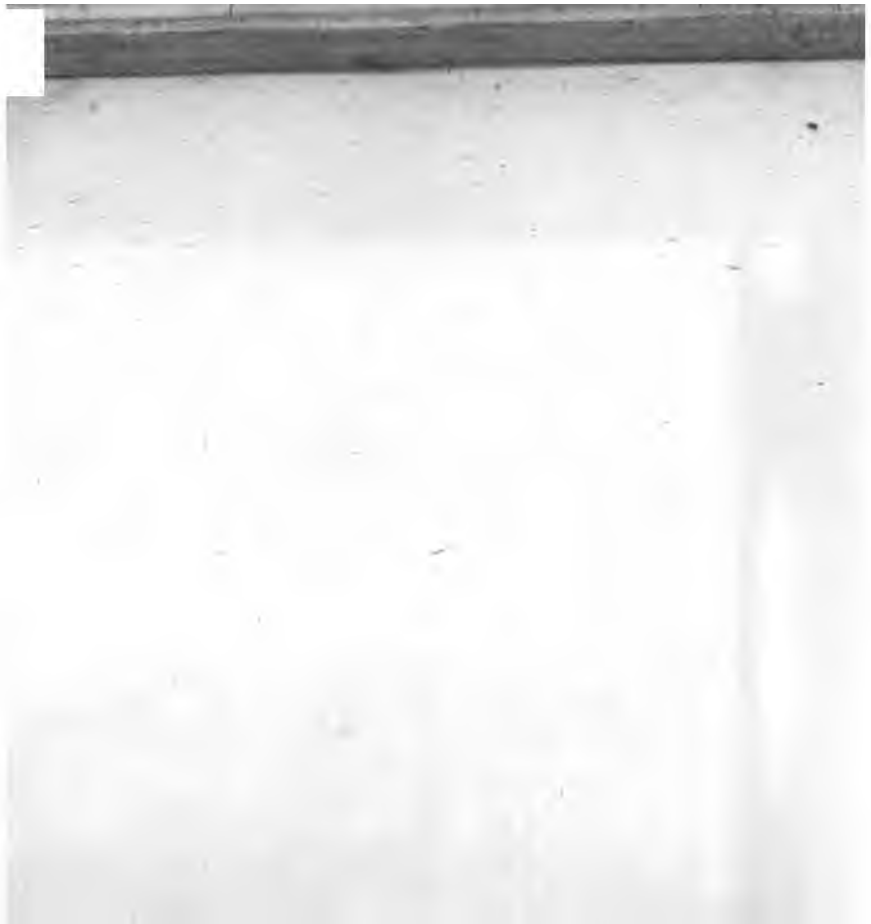
Eutaenia radix. Bd. & Gir. Garter snake.

Skeletons Mounted.

Podilymbus podiceps. Lawr. Pied-billed Grebe.

Botaurus mugitans. Bart. Bittern.









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